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AND

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ENGINEERING NEWS.

SHIP BUILDING IN SCOTLAND is reported upon as follows by the London *Railway News*:—Jan., 1890, 21 vessels aggregating 23,532 tons; February, 28 vessels of 48,388 tons in total. March, 20 vessels aggregating 25,905 tons. The total for the three months is 69 ships of 97,825 tons in total. The total for the Clyde was 81,005 tons in the three months, the largest in the history of the trade, excepting only 1883, when for the same period it was 83,617 tons.

THE GEOLOGICAL SURVEY OF MISSOURI has issued its Bulletin No. 1. The contents include the administrative report of the State Geologist, Mr. Arthur Winslow; The Coal Beds of Lafayette County, by Arthur Winslow; The Building Stones and Clays of Iron, St. Francois and Madison counties, by G. E. Ladd; The Mineral Waters of Saline Co., by A. E. Woodward, and A Preliminary Catalogue of the Fossils occurring in Missouri, by G. Hambach. This bulletin of 85 pages is published by the Geological Survey, with its headquarters at Jefferson City, Mo., as the first of a series to be issued at intervals. They are intended as progress reports to date only, says Mr. Winslow, and the next issue will probably contain some of the results of investigations of the zinc and lead deposits of the State.

FLORIDA PHOSPHATE ROCK, says a correspondent, Mr. D. D. ROGERS, C. E., has been found covering an area of 100,000 acres, and scattered over nearly the whole length of the western part of the State. These deposits run from 65 to 90 per cent. in phosphate of lime and average 10 ft. in depth of deposit. The supply is practically inexhaustible.

THE INTERNATIONAL GEOLOGICAL CONGRESS will hold its fifth annual meeting in Philadelphia in the Autumn of 1891. Geologists of fame from all parts of the world are expected to be in attendance. The committee of arrangements met lately in Washington; Prof. NEWBURY, of New York, is the chairman and the committee includes among its members Profs. JAS. HALL, J. P. LESLEY, E. D. COPE, FRAZER, JOS. LEIDY, G. K. GILBERT, ALEX. WINCHELL, O. C. MARSH, H. S. WILLIAMS, ARNOLD HAGUE, C. D. WALCOTT, J. J. STEVENSON and Major J. W. POWELL.

THE NEW TORPEDO-BOAT "CUSHING" ran between Newport and New York in 6 hours and 57 minutes, an average of 19¼ knots per hour for the whole distance. She did this with hard coal, an inexperienced crew and in the face of a brisk breeze and a choppy sea. On her trial run of two months ago she made 22½ knots for three hours, and her commander, Lieut. WINSLOW, U. S. N., says he has seen the boat travel at the rate of 24.32 knots, or 28 miles per hour. The *Cushing* is 138 ft. long, 15 ft. beam, 10 ft. deep, and with 10 tons of coal aboard her displacement is 117 tons. She can carry 39 tons of coal and with this can steam 4,000 miles at 10 knots per hour. The *Cushing* has also made the run from New York to Washington in 28½ hours, with an average speed of 15 knots per hour. She did this, using only one boiler, with an average steam pressure of 80 lbs., and through thick and heavy weather.

THE GOLD AND SILVER PRODUCTION OF THE U. S. for 1889, is given by Director of the Mint, Mr. EDWARD O. LEECH, as follows: The gold product of the United States was 1,587,000 fine ounces of the value of $32,800,000, against $33,000,000 in the preceding calendar year. Of the gold product of the United States $31,959,047 was deposited at the mints for coinage and manufacture into bars.

The silver product of our own mines for the calendar year 1889 was approximately 50,000,000 fine ounces, of the commercial value of $46,750,000, and of the coinage value of $64,646,464, against a estimated product for the calendar year 1888 of 45,783,632 fine ounces, of the commercial value of $43,020,000, and of the coinage value of $59,195,000, an increase over 1888 of about 4,216,368 fine ounces, of the commercial value of $3,730,000.

In addition to the silver product of our mines, about 7,000,000 ounces of silver were extracted from lead ores imported into the United States and smelted in this country, and over 5,000,000 ounces from base silver bars imported, principally from Mexico, making the total product of our mines, smelters and refineries about 62,000,000 fine ounces of silver. Of this amount the Government purchased for coinage 27,125,357 ounces; there were used in the arts about 6,000,000 ounces; there were exported to Hong Kong, Japan, and the East Indies about 9,000,000 ounces; and there were shipped to London for sale about 20,000,000 ounces.

Colorado still maintains first rank among producing States with an aggregate product of gold and silver of over $24,000,000. Montana stands next with a product of $22,804,000. California produced $14,034,000, of which $13,000,000 were gold, being about two-fifths of the total gold product of the United States. Utah shows a largely increased product, notably in silver. Idaho and New Mexico report an increased product, and Arizona and Nevada a reduced product for 1889. The gold product of Dakota (South) increased from $2,600,000 in 1888 to $2,900,000 in 1889. Oregon and Washington both report increased products, the former having produced $1,200,000 in gold. The States of the Appalachian range show a slightly increased product of gold over 1888.

THE MOUNTAIN IZTACCIHUATL (Is-tá-si-wa-tle), or "sleeping woman," one of the grandest and most beautiful features of the Valley of Mexico, and so called from the striking resemblance of its crest to a woman laid out for burial and covered with a white sheet, has been successfully ascended by Prof. HEILPRIN and Mr. F. C. BAKER, representing the scientific expedition sent out from the Philadelphia Academy of Natural Science. This is the third recorded ascent of this mountain, and the first by a scientific man. The barometer measurements indicate an absolute elevation of 17,150 ft., about 1,500 ft. higher than previous records have made it. A glacier, two miles long, was found to descend the western slope of the mountain, the first recorded as existing in Mexico. On the summit the thermometer registered 28° Fahr. Butterflies were found imbedded in ice at an elevation of 15,500 ft.

THE MOST SERIOUS RAILWAY ACCIDENT of the week is reported to us as follows by a correspondent:

"On the morning of April 28 a freight train of three sections was moving east on the Georgia Pacific R. R., when the first section broke in two (link and pin coupling) in a sag in the grade line at Muscadine, Ala. The first portion of the train backed up, attached the rear portion, called in the flagman, and was moving off at the rate of 6 miles per hour, when the second section struck it. Thirteen cars were derailed and badly broken, the locomotive of the second section was turned bottom upward and the tender thrown on top of it. The trainmen escaped by jumping, though some were badly hurt. This makes the seventh accident at the same sag in the grade line, the grade from the west being 90 ft. to the mile, which prevented the engineman of the second section from stopping his train."

In such a case as this it would seem to be sound policy on the part of the company to improve the grades at the place referred to.

THE BOILER OF A LOCOMOTIVE on the Bangor & Piscataquis R. R. exploded May 3 while the engine was hauling a train near Henderson, Me. Only the forward truck of the tender left the rails. Neither of the trainmen was hurt.

BRIDGE ACCIDENTS are reported as follows: On May 1, the covered bridge over the Bronx River, between Mt. Vernon and Bronxville, on the Harlem division of the New York Central R. R., caught fire from a spark from a passing locomotive. The dry frame structure was soon a total wreck. An iron bridge will be put up at once.——On May 3, timber fires along the Hinkley branch of the Great Northern R. R. (in Minnesota) set fire to the bridge across the ravine between Holley and St. Francis stations. When the west-bound freight train approached the burned structure, the engineer reversed his engine, and, together with the fireman, jumped. The engine, tender and 10 cars went through the burned bridge, a distance of 12 ft., and were entirely consumed. No one was injured.

A CROSSING ACCIDENT occurred, May 1, at Spokane Falls, Wash. A cable car was run into by a freight train at a crossing of the Seattle, Lake Shore & Eastern R. R. Three persons were injured.

HEAVY RAINS in Maine have swollen the streams, causing damage to roads, bridges and culverts.—— A cyclone caused much damage in Hood County, Tex., May 4; 15 persons were killed.

THE LEVEE CONVENTIONS that met in Vicksburg last week, resolved in favor of continuing the present method of protecting the country by levees. It has also decided to petition the Government to aid in this task to the extent of $10,000,000. As showing the comparative efficiency of the later work and the ability of the present levees to resist floods, the New Orleans *Picayune* tabulates the several great floods of late years as follows:

Flood Years.	Breaks.	Width in miles.
1882	284	589
1883	224	341
1884	204	106
1890	23	5

While five deep breaks may do more damage than one hundred smaller ones, it is certainly encouraging to see that the number of breaks decreases. The *Picayune* says that the comparatively small number of crevasses in 1890 is due to the fact that in the preceding six years the levees generally were greatly strengthened, and that there was this year, for the first time, a continuous line of levees from the Arkansas hills to the Gulf, on the west bank, and from Yazoo down, on the east side.

"THE UNITED STATES CENTRAL R. R. CO." decided last week to build *twelve* miles of its road; a small beginning in its ambitious task, if its title meant anything more than words. But, according to its prospectus, this far-reaching name really reaches from Worcester, Mass., to Hartford, Conn., 65 miles, with three proposed branches of 10, 8½ and 5 miles.

A PULLMAN VESTIBULE CAR TRAIN has been put in service between London and Bournemouth (England), on the London & Southwestern Ry. The trip is made in about 2½ hours. The cars were built at the Pullman works, sent over in sections, and put together at the railway company's shops.

A NATIONAL CONVENTION OF RAILROAD COMMISSIONERS has been called to meet with the Interstate Commerce Commission at Washington, May 28. The following subjects are suggested by the Committee for discussion at the meeting: Railway Legislation: How to Obtain Harmony in.—Annual Reports from Carriers: Uniformity in.—Uniformity in Railway Accounting.—Classification of Railway Statistics.—Uniform Classification of Freight.—Railway Construction: Should State or Federal Regula-

tions be Provided?—State Railroads: Should they be Brought Under the Federal Law?—Reasonable Rates: How Determined; Joint Through Rates and Local Rates; Conflict Between Legislature and Courts.—Safety Appliances for Railroad Cars: What Legislation, if any, Should Be Had by Congress?

THE COMMITTEE ON AUTOMATIC CAR COUPLERS of the Master Mechanics' Association has sent out a circular, asking for information as to the number of M. C. B. Std. couplers in use, records of breakages, nstances of accidents from use, and as to whether the ratification of the action of the M. C. B. Association by the Master Mechanics' Association is advisable. Replies are to be sent to Mr. John HICKEY, Master Mechanic, M., L. S. & Wn. Ry., Kaukauna, Wis.

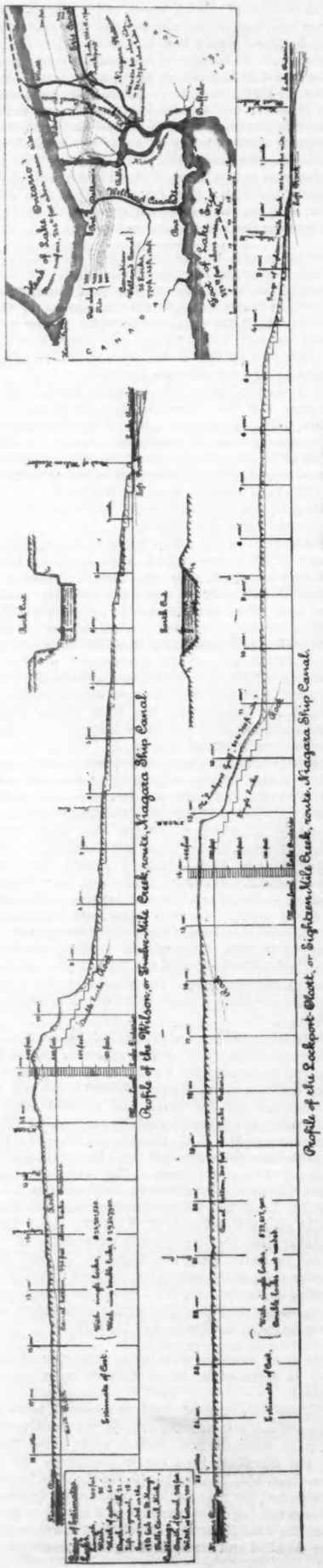
THE MERCHANTS' BRIDGE at St. Louis was formally opened on May 3, in the presence of the Governors of Missouri and Illinois, and a brilliant civic and military display. Speeches were made by Governors D. R. FRANCIS and JOSEPH FIFER, by Secretary NOBLE and others.

THE HUDSON RIVER BRIDGE, proposed by the bill of Judge GREENE, became a law on April 30 without the Governor's signature. This bill authorizes the company to consolidate with a company of the same name incorporated with a perpetual charter in New Jersey in 1868. DELOS E. CULVER is the head of the New Jersey Company, and the union of the two interests can be perfected at any time. No plans whatever have yet been made for the bridge, as far as we can learn, though there are vague rumors of a six-track railway suspension bridge to enter the city about Forty-second St., and to reach to Sixth Ave. with the New York approach. The cost of the structure, including land, is "roughly estimated" at $50,000,000. Five to ten years are talked of as necessary to build the bridge. The whole scheme, in fact, has as yet very airy proportions.

THE DETROIT RIVER TUNNEL BOARD, made up of Maj. C. J. ALLEN, Maj. H. M. ADAMS and Gen. O. M. POE, met, on April 30, in Gen. POE's office, at Detroit, Mich. Dr. SHEARMAN produced models of a tubular tunnel to be built above water and sunk section by section into a trench in the bed of the river, so that not more than one-quarter would be above ground, the tunnel to be 18 ft. in diameter. Mr. SHEARMAN put the cost of the tunnel, without estimating the approaches, at $1,040,000. Objections were raised to this plan, as it might cause the river to become choked with ice and overflow the surrounding country; also, because the anchors of vessels might get foul of it and do considerable damage at any time. Gen. L. S. TROWBRIDGE, in behalf of the Detroit R. R. Tunnel Co., offered to build a tunnel 3,000 ft. long, with approaches 6,000 ft. long, 20 ft. in diameter in the clear, at least 30 ft. below low-water mark and with 80 ft. grade, for $3,500,600; two tunnels for $6,500,000. The tunnel for 3,200 ft. would be composed of a solid combined cast-iron tube, and for the rest of the distance of timber, masonry and cement, the whole to be ready within two years. Mr. LUTHER BEECHER, at the second session of the board, presented his tunnel plan; other plans from Mr. U. S. G. WHITE, of Norfolk, Va., and Mr. C. H. BUCKALEW, of Plainfield, N. J., were submitted. The board has adjourned and will now prepare their report.

THE SUTRO TUNNEL was mortgaged to McCalmont Bros. & Co., of London, for about $1,600,000. To prevent its foreclosure by the McCalmonts the Comstock Tunnel Co. was organized, and this company purchased the Sutro Tunnel from the mortgagee. Three stockholders now charge that there was an attempt to defraud the stockholders by paying for the mortgage out of the funds of the Sutro Tunnel Co., raised, as alleged, on the subscriptions to the income bonds of the Sutro Co. and belonging to that company. The answer made by the Comstock Co., the Union Trust Co., of New York, and Seligman & Seligman and others is, that this plan was given the widest publicity and was the only method of preventing foreclosure in the McCalmont interest, and out of all the stockholders the three plaintiffs have alone made objections.

OFFICERS FOR THE WORLD'S FAIR were elected at Chicago, on April 30 by the directors. Mr. LYMAN J. GAGE is President and Messrs. T. B. BRYAN and POTTER PALMER are the Vice-Presidents. By-laws r the Exposition were also adopted.



The Proposed Niagara Ship Canal; Profiles and Plan Showing the Wilson and the Olcott Routes.

The Proposed Niagara Ship Canal.

The profiles and plan here given show the two routes for the proposed Niagara ship canal practically covered by the bill lately introduced into Congress by Mr. PAYNE. The river and harbor act of Aug. 11, 1888, in referring to this project, instructed the Secretary of War to have the surveys of Col. C. E. BLUNT revised and reported upon. Col. BLUNT, in 1867, made surveys and estimates for a 14-ft. canal, with lock-chambers 275 × 46 ft. He examined six lines, though some of them presented great difficulties in ascending to the Niagara terrace. As the conditions have materially changed since 1867, as to the dimensions required, the Secretary of War, under the act of 1888, detailed Capt. CARL F. PALFREY, U. S. Engineers, to revise the surveys and estimates of Col. BLUNT, and the following is an abstract of Capt. PALFREY's report of Aug. 19, 1889.

Capt. PALFREY only considers the Wilson, or 12-mile Creek route, and the Lockport-Olcott, or 18-mile Creek route. The first is 18.35 miles long, would have 18 lifts, and the estimated cost is $24,201,550 for single locks and $23,347,900 with double locks. The second line would be 25.28 miles long, have 18 lifts, and is estimated to cost $23,617,900.

Both of these plans contemplate canals of 20 ft. depth, with a width of 100 ft. in rock cutting and and 150 ft. at the water surface in earth construction. It is unnecessary to describe the character of the line and location of the locks, as the profiles make this sufficiently clear. It might be said, however, that on the Wilson route the levels between Lake Ontario and the Cliff range in length from 2,000 to 9,750 ft., and this part of the line is entirely in earth-cutting, with a fairly uniform surface. The nine lifts have a rise of 17½ ft. each, with levels of 500 ft. between each. These bring the canal to the summit level, fed by the Niagara river. The cliff is abrupt, with little earth, and the summit is 60 ft. above water-level, making a long length of expensive rock-cutting necessary.

Single locks give on this line a moderate efficiency for draughts of 14 ft. For full efficiency double locks would be required; and as these are all in rock-cutting masonry is reduced to a minimum, but they would cost about twice as much as single locks. In the Niagara River a dredged channel 16,700 ft. long would be required. This is estimated as in sand and gravel, as no rock appears in the river for many miles. At the lake end of both routes the natural harbor is shallow and utterly inadequate in its present improvements for the needs of the proposed canal. A channel 200 ft. wide to deep water, protected by crib-work filled with stone, is estimated for.

The Olcott route begins at the head of Olcott Harbor, on Lake Ontario, and follows the channel of Eighteen-Mile Creek for 3⅛ miles, and ascending, gradually reaches the table-land in 1½ miles more. It passes then 5⅝ miles over this to the foot of the bluff, when it enters another valley 2⅛ miles long before it reaches the bluff proper. It finally reaches the Niagara River opposite the north end of Tonawanda Island.

Beginning at the mouth of Eighteen-Mile Creek this line rises by seven lifts to the entrance of the valley before mentioned, usually called "The Gulf." In this part of the line there is little rock cutting in the bed of the creek and none after leaving the creek. It has one 6-mile level, on which good speed can be maintained. In "The Gulf" the ascent is made by four lifts with 500 ft. levels; then one lift with 800-ft. level; one lift and a level 2,100 ft. long, and then five lifts to the summit with 500 ft. levels. On the summit the rock-cutting extends only about three miles.

On this line efficient service can be had from single locks, and the midway level is an important aid. For 14 ft. draught one lock full of water can be taken from the 800 ft. level and two from the 2,100 ft. level for the service of the lower locks, before drawing from the summit through the upper locks. For 16 ft. and 17 ft. draughts one lock full can be taken from the 2,100 ft. level. A storage basin in the gorge can also be made, into which the water may be allowed to fall from the summit, and thus leave the upper set of five locks entirely free of the duty of replenishing the lower set.

The Olcott route would require a dredged channel in the Niagara river 5,000 ft. long, in sand and gravel. A basin can be dredged in Olcott Harbor

when commercial needs require it; and, meanwhile the estimate includes only a moderate amount for an area of sheltered mooring.

As the locks here estimated for are based upon the plans of the 1881 Sault Ste. Marie locks, the following data concerning these locks may be of interest, and for this data we are indebted to Mr. WM. PIERSON JUDSON, C. E., of Oswego, N. Y.

There are two pair of mitre gates at each end of the lock, designated as "upper and lower lock-gates" and "upper and lower guard-gates," the latter being moved by hand and for use when repairs of lock-gates may be needed. The "lift" of the lock is 18 ft. Each of the eight leaves is built of a framework of white oak, heavily tied with iron rods and sheathed with Norway pine. The upper gates are each 24 ft. high, 39½ ft. wide, 5 ft. thick and one leaf weighs 40 tons. The lower gates are each 42 ft. high, 39½ ft. wide, 5 ft. thick and one leaf weighs 76 tons.

Each leaf of the lock-gates is operated by a separate hydraulic engine, four in all, receiving its power from a water accumulator loaded to give pressure of 120 lbs. per sq. in., which pressure is obtained by the power of two 25 H. P. turbine wheels, worked by water taken from above the lock, and consequently having a head of about 18 ft. Depth on miter sills, 17 ft.; depth in canal, 16 ft.

The new lock now in progress, to be 800 ft. × 100 ft., is to be of equal width in the gates (viz.: 100 ft.). The details of the latter are not yet announced, and appear to be still under consideration.

As to the benefits of such a canal when built, we can do no better than to abstract some of the advantages pointed out by Mr. WM. PIERSON JUDSON, C. E., in his pamphlet entitled "From the West and Northwest to the Sea."

Mr. JUDSON argues that the West and Northwest must have the best possible waterway to the sea, and the best waterway is that one by which the largest practicable lake steamers can go nearest to the sea without breaking bulk. Such a route can be made either through Canada or the United States, and the great profits of the carrying trade will go to the nation providing the best way. With 20,000,000 tons passing the St. Clair Flats Canal yearly at the present time, the magnitude of the future commerce cannot even be estimated.

The United States has so far done her part to provide better communication between the lakes, by building the largest and finest lock in the world at the Sault Ste. Marie Canal; by excavating the St. Clair Flats Canal and by deepening the Detroit River. The latter channel is 20 ft. now and the others are being deepened. It now remains to provide a 20 ft. channel between Lakes Erie and Ontario to complete the chain.

But the Canadian authorities have also been at work, and that Government has spent the, to them, vast sum of $54,000,000 in constructing and improving its canal system with a view of controlling Western trade. This system now includes the 14 ft. Welland Canal and the St. Lawrence River canals, six in number, with 26 locks. These were originally 9 ft. canals, but are now being deepened to 14 ft. Montreal is now practically a seaport with 27½ to 30 ft. of water to the sea. Canada is also duplicating the Sault Canal on Canadian territory by a work now under contract, and has a projected canal system, via Lake Nipissing and the Ottawa River, that would be entirely within her borders, and entirely cut out the lower lakes, making Montreal as near to Lake Superior as Buffalo now is. The construction of this latter route is not immediately probable; but it is possible, and in the total length of 430 miles, only 29 miles are canal the rest would be river and lake.

At present the shipments from the upper lakes, reaching New York, are taken from Buffalo by 352 miles of the 7 ft. Erie Canal to the Hudson River. Those from Lake Ontario are transferred at Oswego by two branches of the Erie Canal, via Syracuse and via Oneida Lake, the latter having 184 miles of canal and river travel and 23 miles in Oneida Lake to reach the Hudson River.

Practically, however, the deep water of Lake Ontario is unused for western lake traffic, as the only access is through the 14-ft. Welland Canal. This canal is too small for the larger upper-lake steamers, and the tolls discriminating against vessels bound to American ports almost prohibit this commerce. Nominally the tolls are the same to all vessels, or 20 cts. per ton of cargo and 2½ cts. per ton of vessels; but this amount is refunded to vessels delivering their cargo in Canadian ports.

It has been stated that the proposed 20-ft. Niagara Canal would only pass vessels into Lake Ontario to see their cargoes go to Montreal, instead of to Oswego or New York. But, as already shown, the water to Montreal is now limited to 9 ft., and 14 ft. is the ultimate now being worked for. A 20-ft. Canadian system has been estimated to cost $70,000,000, and has been declared impracticable.

As to the advantages to the United States, upper-lake steamers could place their cargoes at Oswego in 20 hours after passing Buffalo; passing the canal in 11 hours, and making the 110-mile run to Oswego in 5 hours. At Oswego, the cargoes transferred to canal boats are 145 miles nearer to New York than at Buffalo, and have 168 miles less canal to traverse. The average of many trips to the Hudson shows, for steam canal boat with consort, six days from Buffalo and four days from Oswego. Consequently, including the passage of the canal and trip to Oswego, there would be a saving of 1 1-5 days over the present route from Buffalo. Two independent routes would also have the advantage of competition in transportation.

Measures Adopted for the Safety and Service of Reservoir Dams.*

This paper refers mainly to the numerous examples of dams constructed across valleys in France (including Algeria) and Spain.

The object of such dams is to provide for an increased demand for water by the formation of storage reservoirs which may serve any or all of the following purposes, viz., irrigation of the land, water-supply of districts or towns, driving water-wheels or other motors, feeding navigable canals; and it is stated that where the local conditions are such that a dam of moderate height (up to 66 ft.) would suffice, there would be little difficulty in providing for its safety; but the case is otherwise where dams 200 ft. high have to be built; here the greatest care has to be taken with every constructive detail of the work, and it is the object of the paper to point out what precautions are necessary, and to show what injury has resulted from a neglect of such precautions.

(1.) *Nature of the Foundations.*—In the case of dams of masonry (a material equally good for low as for the highest dams), it is stated that this should be so bedded in and incorporated with the foundation soil as to form a homogeneous whole, which can only be perfectly attained if that foundation be rock, and as examples are given the Almansa and Alicante dams in Spain, built three hundred years ago. These are 66 ft. and 134 ft. high respectively, are founded upon rock, and stand to this day; while the Puentes dam (164 ft. high), which was built about one hundred years ago on alluvial soil was destroyed in 1802, after ten years' existence only, by a flood which never rose higher than 10 ft. below the crown of the dam. When this work was reconstructed in 1881-86 the foundation was considerably widened, and carried down nearly 80 ft. below the valley bottom in order to reach rock. The Grands-Cheurfas dam in Algeria is 98 ft. high, and founded on limestone rock; but on the mountain slope into which one end of the dam was built a cleft full of sand was found, through which the water passed when the reservoir was first filled (January, 1885), and this brought about a breach nearly 33 ft. wide a month after, through which the water rushed and overturned the Sig dam lower down the valley. The Gros-Bois dam (France) was built on clay soil, which became moistened as the reservoir filled and produced a sliding and bulging of the lower slope, which, however, partially recovered as the reservoir was emptied; but this phenomenon was more striking in the case of the Bouzey dam (72 ft. high), which bulged out about 15 inches on the lower side for a length of nearly 150 ft.

As regards the foundation of earthen dams, it should be on an earthy soil, free from vegetable matter, so as to insure thorough incorporation of the material of the dam with that of the soil beneath; but if this soil be not thoroughly impermeable it is usual to build a puddle-wall, or core, in the body of the dam, as in England, a good example of which is quoted in the Jarrow dam of the Liverpool water-works scheme, which is over 85 ft. high. An exception to the above rule is that of the Marengo dam in Algeria—an earthen dam 101½ ft. high, built on basalt rock; but the greatest possible care was taken in the construction of it to prevent percolation of water at the base of the dam, and it has stood well to this day.

A curved plan of foundation is recommended, and is adopted in the Spanish and some French dams; but in Algeria the straight plan obtains, and three dams of this type as above shown, viz., the Habra, Grands-Cheurfas, and Sig, have been breached.

(2.) *Cross section.*—In masonry dams this varies very much, most of the old Spanish dams having an extravagant breadth, while those of France are, on the contrary, too slight, the section having been computed on the assumption that the highest water is more or less below the crown of the dam, and to this error the breach of the Habra dam (Algeria) has been attributed; for the flood of Dec., 1881, exceeded the highest normal water-level in the reservoir by 7 ft., and stood at 2 ft. above the crown. As regards earthen dams, the case is different, as the top is usually very wide and the slopes very flat; what is to be avoided is a rush of water over the crown, and the calculations for stability must be made on the assumption that in high floods the water stands at a level with the crown.

(3.) *Precautions in Construction.*—In the case of masonry dams the stones should be dressed and squared and laid in the best hydraulic cement. Sometimes, for the sake of economy, the best mortar is used only at and near the faces of the dam and inferior mortar in the center, as in the Sig dam in Algeria, which, as before mentioned, was breached; it is evident, therefore, that there is a limit to such economy.

In earthen dams the material should, it is stated, be a mixture of two-thirds clay and one-third sand, and should be tipped in thin layers inclined upwards, and made as compact and water-tight as possible by ramming and rolling, and it is recommended to water the surface of each layer before tipping the next above it. The English method of building a core of puddled clay, it is said, has this disadvantage—that the parts of the dam in contact with the core are apt to crack unless the greatest possible care is taken. The combination or conjunction of masonry with earthen dams is to be avoided, and masonry culverts under high earthen dams are to be regarded as dangerous, and as an instance the bursting of the dam of the Sheffield reservoir is quoted.

(4.) *Limit of Highest Water-Level in a Reservoir.*—This should always be below the crown, especially in the case of earthern dams, and can be arranged in various ways, viz., by discharge-channels with sluice at the head, which can be made to work automatically, and by free overfalls or weirs, the length of which can be determined by prescribed formulas, dependent on the area of the catchment basin. Examples are given of the Almansa masonry dam, where the sill of the overfall is 6½ ft. below the crown, and is only 39 ft. wide, the corresponding catchment area being 77 square miles. The Habra dam has a catchment area of 91 square miles, with an overfall 49 ft. wide on the right side, and another 124½ ft. wide on the left side of the dam, the sill of each being about 10 ft. below the crown. In rare cases only would it be necessary to make a tunnel or culvert through the mountain side for the discharge of flood-waters; but an example is met with in the Fureno reservoir, where the sill of the tunnel is 24½ ft. below the crown of the dam. Occasionally the under or scouring-sluices are used for discharging surplus floods, and the Habra dam is quoted as an example, but this led to the destruction of the dam when the sluice shutters failed to act.

(5.) There should be telegraphic communication between the dam and the village lying below the reservoir, in case of a breach, and it is stated that, for want of such warning when the old Puentes dam was breached in 1802, 680 inhabitants of the village of Lorca (about 7 miles down the valley) were drowned, but this defect was remedied on the reconstruction of the dam in 1885.

Arrangements for Service.—These are, first, the appliances for drawing off the water; and, second, ly, those for cleansing the reservoir from the mud-sand, etc., brought down by floods. For the first

* By Dr. P. KRESNIK.—(*Wochenschrift des Osterreichischen Ingenieur- und Architekten-Vereines*, 1889, page 313), in "Abstracts," Inst. C. E.

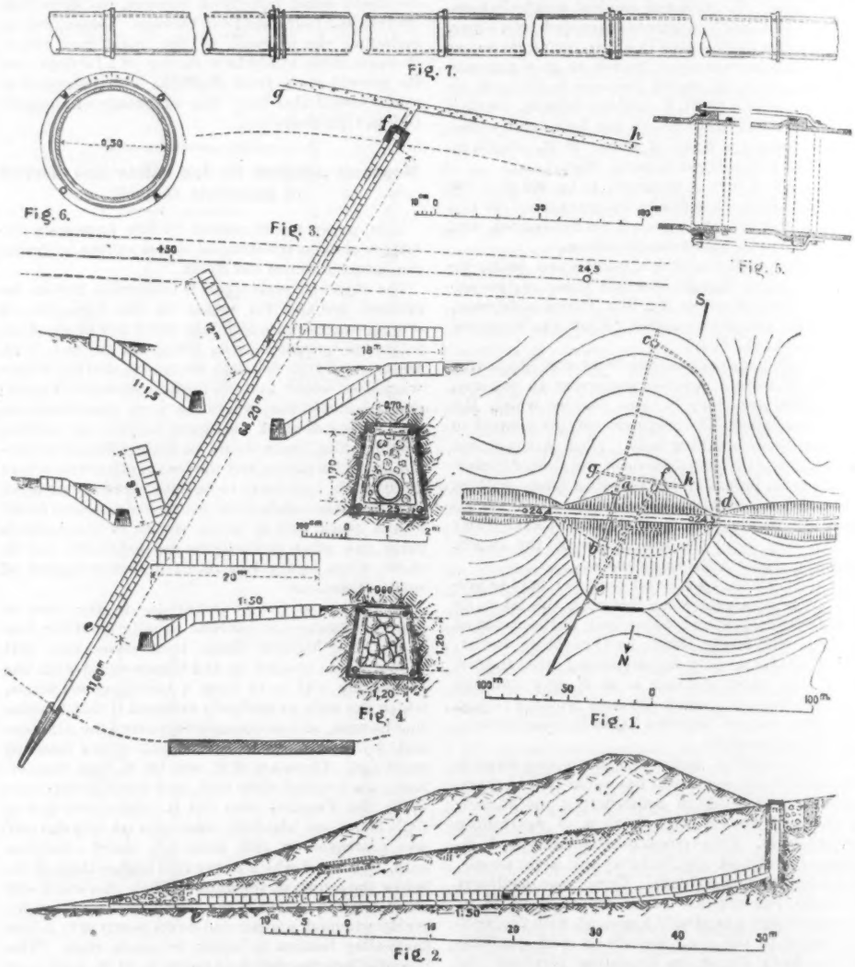
purpose the Spanish system consists of a well, built just within the upper face of the dam and extending to the bottom, and communicating with the water in the reservoir by numerous small openings furnished with shutters, and is drawn off on the lower side through a culvert or pipe passing under the dam. In the French system the openings are fewer and larger, and in the Gros-Bois dam there are only two, the sill of the upper being 18 ft. and that of the lower 60 ft. below the crown. The culvert leading from the bottom of the well is sometimes divided by a short partition wall, in order to make the shutters more easy to work; for instance, in the Vingeanne dam (France) the two branch channels are 2 ft. 7 ins. wide and 3 ft. 3 ins. high, while the main culvert is 6 ft. 3 ins. wide, and a similar arrangement obtains in the Bouzey reservoir.

Scouring or under sluices are constructed for the second purpose above mentioned. The amount of silt deposited in reservoirs depends on the catchment-area, the rainfall, and the geological character of the soil. In the Sig, Tlelat, Djidionia and Habra reservoirs, in Algeria, the yearly deposit is from 0.16 to 1.6 cu. yds. per acre of catchment basin. It is stated that the most simple and effectual method of cleansing the bed of a reservoir is by the sudden opening of a large under-sluice, which produces a violent rush of water which carries off the silt with it; but this involves a great waste of water. The Alicante reservoir was cleansed in this way after an accumulation of ten years' deposit; the cost was £400, and 2,600,000 cu. yds. were removed. But reservoirs should be cleaned out annually, or every three or four years, as the silt is then looser and easier to carry off.

For closing the sluice openings, either beams working in grooves and gates or shutters are employed; the former is the system in the older Spanish dams, and also in the Habra dam in Algeria; it possesses the advantage of simplicity of action, and can be adapted to large openings; but it has this disadvantage, that once opened, the sluice can only be closed again after the reservoir has been emptied.

In the Habra dam four men are employed to open the sluices, and it takes them five hours and a half to open them completely, that is, to a height of 6½ ft., hence much water is wasted in the process; but in the Puentes dam steam-power is used. In the earthen dam of Marengo the sluice is provided with a door, which can be kept closed by a bar or rod hinged on the door at one end, and the other end secured by a pin attached to a draw-bar worked from the top. By lifting out the pin the bar is released, and the pressure of water on the door forces it open; this method, however, has the disadvantage of not being able to close the door again till the reservoir has been emptied.

In order to remedy the defects of the methods hitherto employed, CALMELS and JANDIN have invented special appliances. CALMELS uses compressed air, which is blown on the deposit of silt through a tube and so loosens and stirs it about that it can be carried away by the rush of water through under-sluice. JANDIN uses a pipe or tube, one end of which lies in the deposit of silt, and at the other end is attached a suction-pump; this method is efficient, but costly.



Drainage of a Railway Embankment on the Westerwald Ry.

The Drainage of a German Railway Embankment.

A recent number of the *Centralblatt der Bauverwaltung* contains an account of the way an unstable embankment was relieved by thorough draining.

The Hadamar-Altenkirchen division of the Westerwald Ry., which was built in 1884-86, runs for some distance in the southern part over the basalt foundations of Westerwald, and has also to pass over several large clay beds. Such a deposit, situated near the station of Willmenrod, has proved a source of much danger to the line, has caused the officers no little anxiety, and finally necessitated a thorough system of drainage. By referring to Fig. 1, it will be seen that the embankment in question crosses a little valley near its junction with the larger one through which the Elbe flows. The line winds up this valley at a grade that often reaches 2 per cent. On each side of the entrance to the small ravine is a cliff of basalt and tufa, with rock layers between them, covered at a depth of 6.5 ft. with firm clay. The presence of this stratum was not known until the embankment began to move, and consequently no precautions had been taken against sliding. After the motion of the surface had extended from the western slope almost to the center of the valley, the northern foot of the embankment began to rise. The examination then made revealed the bed of clay, already alluded to, for the first time. The embankment was beginning to slip on this bed. Trenches were dug and the foot of the embankment was made much larger. The motion continued, however. After the division was opened, a regular sinking of the track began, and it was necessary to fill in under the ties continually. The earth of the embankment now began to rise in places, particularly near the northern foot. Hence, it seemed that a counter pressure at this point would tend to restore the normal state of affairs. A large amount of material was added at this place. At first the results were encouraging, but this did not last for any time. Moreover, a wooden conduit that drained the tract above the spot had been destroyed by the movement. This conduit carried the water under the embankment at *a b* in the sketch. Iron pipes had been laid in the culvert for the purpose of maintaining a drain if any accident should happen to the masonry, but these were soon disjointed. A large part of the water could, indeed, be drained away by another channel, from *c* to *d*, in a long curve. At *d* the water passed through a pipe to the northern side. All these methods failed, and the directors were compelled to order a complete draining of the clay stratum and of the embankment.

The plans for the work were drawn up by Herr NEUWIED, their execution was given to Dr. BRAEULER. The principal culvert was at *e f*. It was in a very low position, as may be seen from Fig. 3. The width within at the bottom was 4.1 ft., at the top 2.3 ft., the height was 5.58 ft. It was planned so as to tap the greatest possible number of subterranean streams and also to carry off the water in the neighborhood of the broken drain. The culverts, which were filled with broken stone, served also to drain the subsoil on which the structure rested. In this, they are aided by a ditch *g h*, with a broad and deep section, the bottom being below the upper surface of the clay bed. All water falling above the embankment will be collected in the ditch and lead to the mouth *f* of the main drain. From there it passes through a 1.5 ft. iron pipe laid in the culvert.

The nature of the case made it necessary that the side drains should penetrate the mass of the embankment as well as the surfaces of motion. The main conduit, however, it was necessary to protect from all chances of failure; hence its deep position. The side channels were inclined as shown in Fig. 3.

The drains could have been dug without wooden linings, but the clay of the bed in which the side drains terminated became so soft on exposure to the air that it was necessary to put in a heavy wooden casing throughout the entire system. After the main conduit was built and the side culverts were being dug, the pressure of the moist clay was great enough to several times break the woodwork. It sometimes became necessary to widen the drains also on account of the diminution of the section due to the same cause, even if the lining was still intact, though bent.

The side drains were driven as far as the ground remained damp. Then they were filled with broken stone. The final step was to lay the iron pipe before mentioned in the principal culvert, and to complete the filling of the entire culvert with stones. The method of joining the pipes is of interest. Each section was about 13 5 ft. long. These had to be connected in such a manner that any motion of the drain would not destroy the conductivity of the line. This was accomplished as shown in Figs. 5-7. Two pipes are connected to each other by ties running their entire length; then these pairs are joined in

the same way. The way in which the ties and the pipes are connected is shown in Fig. 5. The rods are bent at one end, laid against the pipe, and a ring slipped over the ends. The other extremities pass through a flange of angle iron fixed on the second pipe, where they are held in position by nuts. Two ties are used for each pair of pipes and they are placed at right angles on the successive pairs.

Since the completion of the work, all motion of the embankment has stopped.

Hindu Arithmetic.

In a late issue of *Science* is an abstract of an interesting article on Hindu arithmetic, published by Mr. FREDERIC PINCOTT, M.R.A.S., in the April number of *Knowledge*.

Mr. PINCOTT explains why small Indian boys mentally make arithmetical calculations with a rapidity that is astonishing to Europeans. The Hindu schoolmasters use terms unknown to English teachers, but which are calculated to greatly lessen the mental labor of the pupil.

Indians use monosyllables similar to ours, from 1 to 10; but from that point the words are built on the model of "1 and 10," "2 and 10," "3 and 10," etc.,[1] up to "8 and 10;" but the word for 19 means "minus 20." After 20 the same method is continued; "21" being imposible, the form is invariably "1 and 20," "2 and 20," up to "minus 30," "30," "1 and 30," and so on. The object of this nomenclature is to facilitate computation; for, in reckoning, the mind has to deal with the even tens, the simplest of all figures to multiply. Thus the question, "9 times 19," is not a simple one to an English child; but the Indian boy would be asked, "9 minus-twenties." In an instant he knows that he has only to deduct 9 minus quantities from 9 twenties, and the answer 171 comes before the English boy has fully realized the question. The formidable difficulty of the 9 is thus completely got rid of by a mere improvement in nomenclature.

Another advantage that the Indian boy has is the use of short, mostly monosyllabic, terms for every ascent in the decimal scale, thus such lumbering expressions as "one hundred thousand" are unknown to him, the simple word *lâkh* conveying the idea fully to his mind. So, also, "one thousand millions" is *arb;* "one hundred thousand millions" is *kharb;* and so on. The advantages of this terseness must be at once apparent.

It is, however, with respect to fractional numbers that the advantage of the Indian system of nomenclature becomes most conspicuous, when once understood. They employ a large number of terms, which are given below.[2]

These terms are *prefixed* when used in combination with whole numbers, the object being to present the special modification to the mind before the number itself is named. Complicated as this nomenclature appears at first sight, its difficulties disappear when brought to the test of practice. It is the outcome of centuries of practical experience, and the thoughtful application of means to an end. It will be sufficient to illustrate the use of these words, and the extraordinary arithmetical facilities they afford, if the use of *paune* is explained, that is, ¾, that being the fraction which the English child has most trouble with. The Indian boy knows no such expression as 'two and three-quarters;" in fact, the term "three quarters" in combination with whole numbers has no existence in his language. His teacher resorts to the same device as has been explained when speaking of the figure 9; he employs a term which implies 'minus." By this process 2¾ becomes *paune tîn*, that is, "minus 3," or "a quarter less 3;" and in the same way 3¾ is *paune châr*, that is, "minus 4;" and so on.

Precisely the same plan is adopted with reference to the term *sawâ*, which implies "one-quarter more:' thus 3¼ is *sawâ tîn* = "plus 3;" 4¼ is *sawâ châr* = "plus 4;" etc. It will now be seen that the *whole* numbers form centers of triplets, having a minus modification on one side, and a plus modification on the other. This peculiar nomenclature will be clearly apprehended by the following arrangement:

2¾ paune-tîn—3	3¾ paune châr—4	4¾ paune pânch—5
3 tîn 3	4 châr 4	5 pânch 5
3¼ sawâ-tîn +3	4¼ sawâ-châr +4	5¼ sawâ-pânch +5

In multiplying these fractions, therefore, the Indian boy has to deal only with only the minus and plus quantities. A simple instance will illustrate this. "Seven times 99¾" would be a puzzle to an English child, both on account of its lumbering phraseology and the defective arithmetical process he is taught to employ. The Indian boy would be asked, "*Sât paune-sau ?*—three words meaning "seven minus-hundreds!" The very form of the question tells him that he has only to deduct 7 quarters from 700, and he instantly answers 698¼. Equal facility is found with any similar question. such as "5 times 14¾?" The Indian boy is asked. "Pânch paune-pandrah?" *i. e.*, "5 minus-fifteens?" As the words are uttered he knows that he has only to deduct 5 quarters from 5 fifteens; and he answers at once, "Paune chau-hattrah," *i. e.*, "a quarter less four-and-seventy" (73¾).

The Indian boy's first task is necessarily to commit to memory the names of the figures from 1 to 100. He is next taught that there are nineteen places for figures, and their names. These correspond to our units, tens, hundreds, etc., but the monosyllabic curtness in the names of the higher numbers is his distinct advantage.

What we call the multiplication table then begins. In England the multiplier remains constant, and the multiplicand changes: thus children repeat, "twice one, two; twice two, four; twice three, six, etc. In India the boy is taught to say, "one two, two; two twos, four; three twos, six, etc.; his multiplier changing, while the multiplicand remains fixed. Another peculiarity is this: he begins at 1, not at 2; and this furnishes him with a series of most useful collective numbers. Here, again, the English language lacks terms to translate the first table, but an idea may be gained from the following attempt: one unity, one; one couplet, two; one triplet, three; one quadrat, four; one pentad, five, etc.

These names for aggregates, as distinguished from mere numerals, are of much value to the boy in the subsequent processes, and give him another distinct advantage.

In learning these tables the boy is not carried beyond 10; that is, he goes no further than "two tens twenty," "three tens, thirty," etc.; but to make up for that forbearance he is carried on in this process of multiplying figure by figure not only to 12, or up to 20, but he goes on through the thirties, and does not make his first halt until he gets to "ten forties, four hundred.!' In achieving this result something more than mere memory is brought into play, for he is taught to assist his memory by reference from one table to another; thus the first half of the six table is contained in the three table, etc

A short supplementary table is next taught, beginning at 11 × 11 to 20 × 11, and then proceeding to 11 × 12 to 20 × 12, and so on up to 20 × 20. This method reduces considerably the tax on the memory; for one-half of the table is obviously the same as the other half, and therefore only half calls for special effort.

The boy has now committed to memory the multiplication of every figure from 1 × 1 to 20 × 20, and in addition he knows the multiplication of every figure up to 40 by the ten "digits." It will be observed that both tables end at 400 (10 × 40 and 20 × 20); in fact, 4 is the most important factor in Hindu arithmetic, all figures and fractions being built upon multiples and fractions of it.

At this point, instead of practising on imaginary sums in the hope of learning arithmetic empirically, the Indian lad immediately proceeds to tables of fractions, the first being the multiplication of every figure from 1 to 100 by ¾. Here, again, ¾ would be the last fraction we should attempt; but in India it is the first, and, by the superior system of nomenclature there in use, it is a very easy affair. The boy, knowing the multiplication of the whole numbers, is taught to deduct the half of the half (¼), and the thing is done. Memory is assisted by observing that every multiple of 4 is a whole number, and that the number below it will always be a *sawâ* of the next lower figure, and the number above it always a *paune* of the next higher figure. Thus in answer to the question ¾ × 36, the Indian boy says mentally, 18, 9, 27; he also knows that 36 is the ninth multiple of 4, and by immediately deducting 9 can get his 27 that way also. Knowing, also, that 36 is a multiple of a 4 yielding 27, he knows that 35 will yield *sawâ chhabbis* (26¼), and that 37 will yield *paune athâ,is* (—28=27¾). In this way three-fourths of the table is a matter of logical necessity, resting on the elementary tabled previously acquired.

In the next table the boy is taught to multiply every figure from 1 to 100 by 1¼. This, of course, is precisely the reverse of the last: the ¼ is ascertained and added, instead of being deducted. Here again, the multiples of 4 are whole numbers; but the figures preceding result this time in a *paune*, and those next following in a *sawâ*. This table also costs but little effort when thus taught.

The next table teaches the boy to multiply from 1 to 100 by 1½, and of course means simply adding half the multiplier to the figure itself.

The next step, multiplying from 1 to 100 by 1¾, is achieved by simply adding three-quarters of the multiplier to the multiplier itself. The "three-quarters" table has been already acquired by the boy, and he has therefore only to add any given multiplier to it. Thus, if asked, "What is 27 times 1¾?" he knows that 27 *paunes* are 20¼: he has therefore only to add this to the 27 itself to get 47¼ as the instant answer.

The boy is next exercised in multiplying 1 to 100 by 2½, and he is taught to do this by adding half the multiplier to the "twice-times" table.

Then follow similar tables multiplying by 3½, 4½ and 5½; and the results are arrived at instaneously by adding to the "three-times," "four-times" and "five-times" tables half the multiplier in every case.

In all these tables the rapidity and simplicity is in great part due to the terms employed. The boy is not asked to "multiply seventeen by three and a half," or "what is three and a half times seventeen?" or puzzled by any other form of clumsy verbosity. The terms he uses allow him to be asked "*sattrah hânthe*" ("seventeen three-and-a-halfs"). His elementary table has taught him that 17 × 3 = 51, and he knows that he has only to add half 17 to that, and the sum is done.

The final task of the Indian boy is the money table, which deals with a coinage which may be thus summarized: 16 *damrî*=1 *takâ*; 16 *take*=1 *ânâ*; 16 *âne*=1 *rûpi*.

There is a small coin called *dâm*, three of which make 1 *damrî*; and therefore 48 make 1 *takâ*, and 96 = *ânâ*, 4[2] being still the unit. The table imparts a familiarity in combining these coins together.

This completes an Indian boy's most elementary course of arithmetic: and a little reflection on the great facility for computation which Indian children show, and the simplicity of the means by which it is effected, ought to make us rather ashamed than boastful of our own defective methods.

The Artesian Wells of Memphis, Tenn.

The artesian wells of Memphis, Tenn., have transformed the water supply of that city from what was "horribly bad" a few years ago to a supply of pure and wholesome water. Dr. SAFFORD, of the Tennessee Board of Health, says that the first change from shallow wells contaminated by sewage was made about five years ago, when water was introduced from Wolf River at a point about 12 miles from the city. This water, however, was very muddy. In 1887 a local ice company demonstrated the fact that pure water could be obtained from artesian wells, and this discovery has led to the completion of a system of artesian wells for the general water supply.

The first well sunk was 354 ft. deep, and an abundant supply of excellent water was found at that depth. Dr. SAFFORD says that in and about Memphis the top soil is loam for from 25 to 60 ft. in thickness of stratum; below this is sand and gravel for about 25 ft., and beneath the gravel is a layer of impervious clay 145 ft. thick, and below this again is the great water reservoir, a stratum of water-bearing sand almost 800 ft. deep resting on a bed of clay.

This lower sand stratum and the inclosing clay beds dip toward the west, and in going eastward from Memphis they appear on the surface in Fayette Co., and a strip 20 miles wide and of indefinite length is here exposed to the rainfall. This gathering belt is from 45 to 60 miles from Memphis, and the fall is about 600 ft.

[1] This is also the original meaning of the English words "eleven," "twelve," etc., up to "nineteen."

[2] Pâ,o = ¼; adh = ½; paun = ¾; paune = —¼ (¼ less than any number to which it is prefixed); sawâ=1¼ (¼ more than any number to which it is prefixed); sârhe = +½ (½ more than any number to which it is prefixed); derh = 1½ (a number + half itself); pawannâ = 1¾; arhâ,i = 2½ (twice and a half times any number); hûnthâ = 3½; dhaunchâ = 4½; pahûnchâ = 5½.

The city's water supply is obtained from 32 wells of an average depth of 400 ft. In each case the water rises through a steel tube 8 ins. in diameter, with a 50-ft. brass strainer at the bottom. The water does not come directly to the surface; but in the impervious clay a tunnel, 3,000 ft. long and 5 ft. in diameter, has been driven, and into this the 32 wells discharge. This tunnel is 30 ft. below the top of the clay stratum, and about 75 ft. below the level to which the artesian well water freely rises.

Near one end of the tunnel there is a pump-house, under which the water from the wells and the conduit rises into strongly-built chambers, from which it is pumped and distributed. The three pumps have a capacity of 30,000,000 gallons a day. The floor of the lower chamber is 50 ft. below the highest level of artesian flow, and the top of it is closed with a heavy and securely anchored cover strong enough to resist the upward pressure.

Experts say that this water is exceptionally pure. Among those who have analyzed it are Dr. CHARLES SMART, United States Army; Prof. J. W. MALLETT and Prof. E. H. S. BAILEY. Says Dr. SAFFORD: "It is clear, colorless, with a minimum of mineral substances and wonderfully free from organic matter. It is, furthermore, sparkling, pleasant to the taste and refreshing, without odor, slightly chalybeate, and, as it comes from the wells, has a temperature of 60° Fahr. constant the year round. Showing no traces of sewage and being thoroughly secured against sources of pollution, there can be no doubt as to its wholesomeness; and this the improved health condition of Memphis since its introduction would appear to demonstrate."

A 24° Curve on a Trestle.

We are indebted to Mr. J. H. PADDOCK, Chief Engineer for the H. C. Frick Coke Co., of Scottdale, Pa., for the trestle plan here given. This trestle is located on a 24° curve on a steep side hill and is traversed by a 10-ton engine hauling trains to the coke ovens.

The chief interest lies in the method adopted by Mr. PADDOCK for securing the elevation of the outer rail on the sharp curve found necessary. The advantage claimed is considerable economy in material, and the result has been more satisfactory than was the older practice tried at other parts of the same line. The cut is sufficiently clear in itself without further explanation.

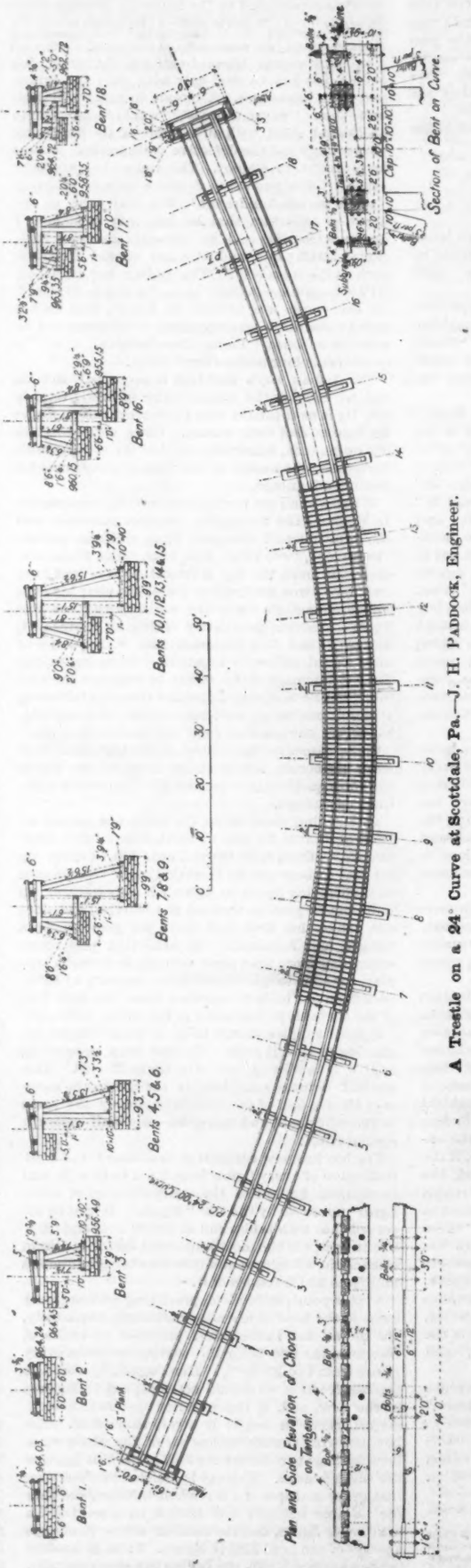
Sanitary Service of Amsterdam.

United States Consul ECKSTEIN, of Amsterdam, has recently published an article on the sanitary service of that city. Speaking of the drainage of Amsterdam he says there are now two distinct systems. The first is a flushing system by which all liquid and solid impurities, excepting ashes, kitchen refuse and street sweepings, run to waste in the canals through brick drains. The second is the Liernur system, which separates the refuse so that only rain and slop water run into the canals, and the solid matter is collected and sold to the agriculturist at a high price. This system has been often described; it is practically a network of pipes and reservoirs operated by an air exhausting engine in such a manner as to convey the more solid matter to a central reservoir.

At the end of 1888 2,847 blocks of buildings, containing 50,240 persons, were connected with the Liernur system in Amsterdam. The quantity of matter collected annually amounted to nearly 12,000,000 U. S. galls. There is in addition to this main system an outlying system in which each house has its own reservoir, and these reservoirs are emptied into tank-boats by air-pumps. Nearly 9,000,000 galls. were collected in this way in 1889.

The exchange tub system is worked in 334 blocks of buildings and requires 1,505 sets of tubs; these are daily carried from the houses in well-closed carts and taken to the main station, where they are emptied, cleaned and disinfected. The average number of tubs exchanged per day is 810, and the quanity of soil collected amounted in 1889 to about 400,000 galls. Cess-pools of the ordinary kind, of which there are 3,567 large ones and 7,495 smaller ones, are emptied into carts in a very unsightly manner. In the better part of the city the cess-pools are emptied by the Latrine machine. The 237 public urinals are flushed once per day andpainted with carbolic acid and black varnish.

Ashes and street sweepings and refuse are collected in carts. This refuse is assorted, and parts of it sold. It was at first proposed to turn the fæces into "poudrette," but this plan was a failure, and at present tests are being successfully made to turn them into sulphureted ammoniac. What remains of the fæces from these experiments is put into a brick reservoir, 217 ft. × 83 ft., and 13 ft. deep, and is sold to farmers for manure. The total receipts in 1888 for this manure amounted to $55,840. The total of ashes and refuse brought to the main station by carts and boats in 1888 amounted to 117,363 cu. m. Excluding inspectors, the collecting force amounts to 300 men. For street sweeping 115 horses are required.



A Trestle on a 24° Curve at Scottdale, Pa.—J. H. PADDOCK, Engineer.

The Engineering Census of Nebraska City, Nebraska, for 1890.

We are indebted to Mr. A. F. NIMS, City Engineer of Nebraska City, Neb., for the following abstract of the returns made by him for the census of 1890, which returns are interesting as showing the nature of questions asked and answered in connection with this branch of the census:

The total length of all streets and alleys in Nebraska City is 74 miles. Of these streets, 0.9 miles are paved with brick; 1.1 miles with wood and 7 miles of streets and alleys are unimproved. The average width of streets between building lines is 76 ft., and the widest street is 82½ ft. and the narrowest 46 ft. (Public improvements were first started here only in 1888.) The average width of pavements is one-sixth of the width of streets; and of the sidewalks now improved, 4.5 miles are brick; 1.5 miles stone; 0.7 miles asphalt, 6 miles wood and 0.5 miles cinder. Nearly all resident streets have shade trees set out on both sides, placed there both by the city and by property owners. All residence streets have grassed places between the building lines. The average yearly cost of all street work, exclusive of cleaning, for the past year, is asked, but in this case "no account" was kept. The paved streets are cleaned weekly by hand; but the "average yearly cost of street cleaning for the past 10 years" is not answered in this case, for obvious reasons. The "final disposal" of street sweepings is also required; as are the disposal of garbage by city or residents, the frequency of such removal, and the type of vessel required.

Under the head of drainage report for cities of 10,000 and upwards the total length of sewers is given as 5 miles of mains, or 4.1 miles of 8-in. pipe sewer, 0.11 miles of 12-in. and 0.56 miles over 18 ins. in diameter. There are 0.23 miles of brick sewers between 30 and 36 ins. in diameter. The largest sewers are 36 ins. and the smallest 8 ins. in diameter. The drainage system has two outlets, one into the Missouri River and the other into North Table Creek. All house connections are made with 6-in. sewer pipe and are not included in above estimate. There are 63 manholes, 16 catch basins, 20 flush tanks, 60 house connections and 8 privy vaults connected with the sewers in the system. The total number of privies and cesspools not connected with the sewers is also required. The total cost of sewers to date, aside from cost of maintenance, is $27,281.63. As they were all built in 1888, the question as to average yearly cost of maintenance for "the past 10 years" is answered by "no cost." The cost of cleaning per year is asked. The remaining questions relate to the length and material of covered drains, and a request for a drainage map of the city, showing all sewers above 18 ins. diameter.

The third report is on the altitude, topography, etc., of the city. Here it is stated that Nebraska City is 600 ft. above mean tide level in the highest point and 497 ft. in the lowest. These heights are deduced from a government bench-mark on the Missouri River. Th city is situated on navigable water; that is, the Missouri River, with good landing, but no timber wharves. The final questions are—(*a*) character of soil; (*b*) underlying rock; (*c*) variations of level; (*d*) streams and watercourses; and (*e*) is the land for a radius of five miles about the city open or wooded

The New Water-Works at Covington, Ky.

(WITH INSET.)

We begin this week the illustration of the new works supplying water to the city of Covington, Ky., put in operation a few months ago. The works were built under the direction of Mr. G. BOUSCAREN, of Cincinnati. On our inset page is shown a map of Covington and vicinity, plan of the storage and settling reservoir; plan and sectional elevation of the pumping station, and a sectional elevation of the chimney at the station.

The complete description of the works, prepared for this journal by Mr. BOUSCAREN, with the remainder of the drawings, will be given in our next issue.

The Water-Works of Ypsilanti, Mich.*

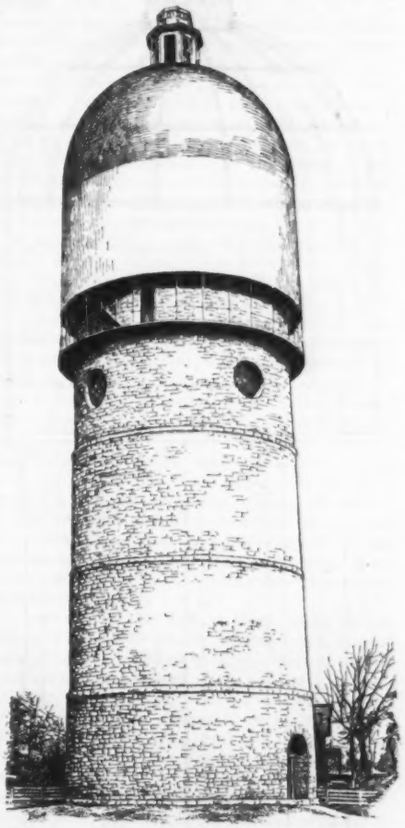
The plan of the Ypsilanti water-works is based on the pumping and elevated reservoir service combined, both ordinary service and fire service being furnished direct from the street mains. There is a broad distinction between this system of works and what is called the "pumping to stand-pipe" system.

It is superior to the pumping and open earth reservoir system, chiefly from the fact that the water in the perfectly inclosed elevated reservoir cannot deteriorate from exposure, as in the open reservoir. It is superior to the simple so-called direct pressure service, both in regard to economy and efficiency of service. In the direct service, at the moment the pumping machinery stops the entire service is dead, and in no case, even under the most pressing necessity, can the service from such works possibly exceed the simple capacity of the pumps. Nothing can be stored up for use in time of dire necessity and peril; while to be prepared to meet extraordinary demands, even in an imperfect manner, we must keep expensive reserve machinery in constant readiness for use.

It is impossible to pump water economically in the direct service because we never know what we have to do. At one hour of the day we may be called upon to run our pumps at their full economical capacity, at another hour of the same day, perhaps only one-fifth of this service will be required, yet we must be ready at all times to meet all calls as they come. With our elevated reservoir we are perfectly prepared at all times for all emergencies. We can run our pumps at all times at the same speed, and under the same pressure, working to their full economic capacity regardless of the current consumption. Whatever excess of water there may be pumped above the ordinary current consumption will go into the reservoir, there to be stored to carry the night service, when the pumps are idle, or to meet any extraordinary demands, even while the pumps are running, that may temporarily exceed the pumping capacity.

To illustrate: We are building works for a small city, where 500,000 galls. of water per day will be the maximum consumption for ordinary service. If we are to have a fire service, as well as ordinary service, direct from the mains, we must be prepared to supply on short calls for fire service four times what this maximum ordinary service requires. If we are working under what is generally called the direct pumping plan, having nothing but our pumps to rely upon, then these pumps must be of five times the capacity needed for ordinary work, and this excess must always be kept in readiness for instant use. If we consult the statistics of the different cities, we find that the amount of water required for fire service, for a whole year, averages less than one day's ordinary consumption for those various cities, yet to do this one day's work, on the direct plan, we must keep our four-fold excess of pumping capacity in readiness for use 365 days in the year.

The great claim made by the advocates of the direct service plan, consists in the saving of the cost of the reservoir, to start with, and that in working direct, the pressure can be regulated to meet the varying requirements of either ordinary or fire service; that while ordinary service will be usually satisfactory at a pressure of 45 or 50 lbs. per sq. in., effective fire service will call for 95 to 100 lbs., and that as the great bulk of the water is only required for ordinary service, it is much less expensive to raise it 100 ft. high than it will be to raise it 200 ft. high. This would be true if we could work to advantage and run our pumps to their full economical capacity, but this is impossible pumping direct to your consumers, for the pumps must follow the varying demands of the consumers working to perhaps their full capacity at one hour, and at one-fifth capacity at another hour of the day.



Elevated Reservoir, Ypsilanti, Mich. From a Photograph.

Nor is this all, or even the worst feature of the varying pressure, direct service. In nearly all our public water-works systems, the amount of water running to waste greatly exceeds the amount used for strictly necessary purposes, I think it is safe to say that 75 per cent. of all the water used escapes from faucets partially opened and constantly running. Of course, these openings are all gauged to give the required amount of water under the ordinary pressure. A fire breaks out and at once the pressure must be doubled. What is the result? Your waste is doubled, and your fire service handicapped from every direction. Your pumping machinery is usually not adequate to meet all these demands effectively. Your mains are not large enough to carry this extraordinary amount of water without a frictional loss that will very seriously impair the efficiency of such service as your handicapped pumps may still be able to render. And over and above all, in many cases your water supply will not be adequate to meet all these wants and wastes.

The city of Kalamazoo furnishes a striking illustration of this. This city built works on the direct, variable pressure service plan in 1888-9. The water supply is taken from a large well which for 18 years has shown a capacity to meet any demands made upon it, not exceeding 4,500,000 galls. per day. During the dryest part of the season of 1887 the consumption of the city on some days reached the enormous amount of 3,500,000 galls. per day, or 350 galls. per capita per day, for all that part of the population supplied, and this only for ordinary service, and at the ordinary pressure of 45 lbs. at the pumping station. If at such a time, when the ordinary consumption is so large, a fire breaks out, calling for double the pressure, and water at the rate of 2,000,000 galls. per day in addition to the ordinary service, what can be done? The increase in the ordinary service, due to the increased pressure, would fully exhaust the 4,500,000 gall. well, leaving nothing at all for the fire work.

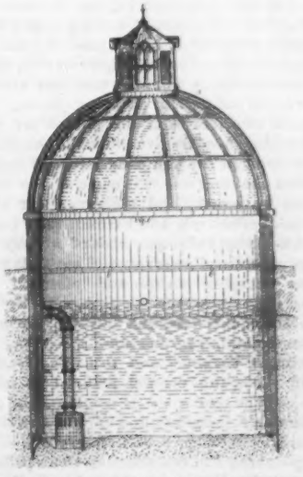
Added to all this we must consider the great increase of work put upon our pumping machinery by this enormous increase of waste due to the increased pressure, and the further fact that the mains, rarely large enough for effective legitimate work, are here so greatly overtaxed that the resulting frictional loss renders effective work impossible. In 1887 the authorities at Kalamazoo saw the danger of the situation, and took steps to provide for it. But instead of taking the proper course and providing an elevated reservoir (for which the natural conditions are very favorable at Kalamazoo), another well was decided upon, constructed and connected with the old well.

The expense of this work was about $30,000, and has resulted in an addition of about 60 per cent. in quantity to the water supply, but has very greatly impaired the quality.

If this same $30,000 had been expended in constructing a reservoir, and properly connecting it with the street main distribution, it would have added four-fold to the efficiency of the fire service, it would have largely decreased the running expenses of her works, her old well would have furnished an ample supply for years to come, and the quality of her water supply would have remained unimpaired.

With an elevated reservoir in connection with the pumping service in Kalamazoo, the reduction in salaries at the pumping station would alone equal the interest on the entire cost of such reservoir, and notwithstanding the fact that with the reservoir the pumps would necessarily be working under 90 lbs. pressure, instead of 45 lbs. as now. Yet the total cost would be less per million of gallons of water pumped, than now, and as before said, the efficiency of the fire protective service would be increased four-fold.

The stand-pipe cuts so small a figure in water-works construction, considered purely on its merits, that but for the fact that the great majority of the people hold such vague ideas concerning it, it would not be worthy any extended notice.



Supply-Well, Ypsilanti Water-Works.

The original intent of the stand-pipe was to provide a relief for the pumping machinery and mains against the shock of suddenly changing pressures. A stand-pipe of proper height, and in size equal to the force main, would serve this purpose as well as one of larger size. Of late years, stand-pipes of much larger size have become quite popular with many engineers. The only added merit these stand-pipes

*Condensed from a paper by W. R. COATS, read at the Annual Convention of the Michigan Engineering Society.

possess, over the smaller ones, simply consists in their added storage capacity, and this is at best too small to cut any important figure. Let us take for illustration a stand pipe 15 ft. in diameter, and 150 ft. high. This seems to be quite a popular size. Such a structure will hold a little less than 200,000 galls. of water, and will cost $10,000, or 5 cts. per gall. for every gallon of water it contains, and this will leave it entirely naked under full exposure. If we inclose it, as ought to be done, then it will cost as much more.

But in such a stand-pipe only one-fourth of this water will do effective work, so that this raises the cost of our structure virtually to 20 cents per effective gallon, if naked, or 40 cents per gallon if inclosed. Such a structure cannot do fire service longer than 30 minutes without reinforcement from the pumping station, nor can it do good ordinary service long enough to enable us to reduce the working force at the pumping station; hence such a structure can never pay back during its natural life-time one-fifth its original cost.

As an engineer, I never feel justified in sanctioning such structures, even in cases where I find a strong popular prejudice in favor of them. I do not believe there exists any valid excuse for such structures, or that there is a man living who can give a sane reason in defense of them. I think that when this stand-pipe folly is abandoned by our profession one quite considerable obstacle to water-works construction will be removed in many of our small cities.

A properly constructed water-works, on the pumping and elevated reservoir plan, should consist of a pumping plant of at least double the capacity required by the maximum consumption of the ordinary service, so that the full 24 hours' supply can be pumped by working half time, and with one set of men; and a reservoir of sufficient storage capac- to carry the ordinary service during the night, and to meet the demands for fire protective service at all times. Of course, the reservoir must be placed at sufficient elevation to afford efficient fire pressure.

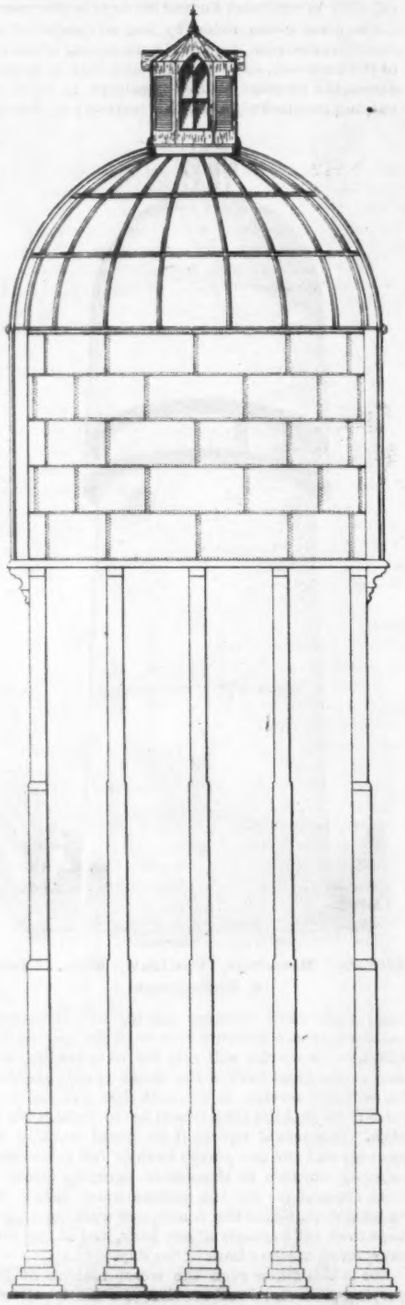
In order to secure the best results, the pumping station and reservoir should be on opposite sides of the city, the street main distribution lying between. This arrangement will reduce the frictional loss in the mains to a minimum, and secure the highest degree of efficiency in the service. The pumps and reservoir will be connected directly through the street main distribution, and when the pumps are running, all the ordinary service will be supplied direct, the pumps always running up to their full economic capacity, without any regard to what may be transpiring throughout the distribution, the aim being to pump all the water in 10 or 12 hours that will be required during the 24 hours.

Of course the excess of water pumped beyond the ordinary requirements, will pass into the reservoir, there to be stored for the night service, and to meet any extraordinary demands that may arise. Should a fire break out during pumping hours, calling for water in excess of what the pumps are delivering, no attention need be given it at the pumping station, as the moment the pumps fall short of supplying the demand the reservoir will come to the rescue with its reserve power, and both reservoir and pumps will work effectively and harmoniously together.

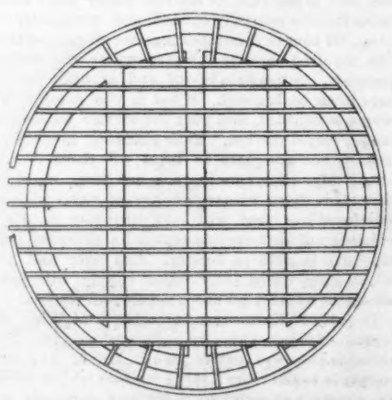
It is now that the importance of a proper location of out pumps and reservoir will most plainly appear. If our pumping station and reservoir had been placed in juxtaposition, as is usually the case with the stand-pipe, thus compelling both to work through the same main, from the same direction, instead of working in harmony and full effectiveness there would be constant conflict, and at best but half service could be rendered. It would not be possible to establish a satisfactory and effective frictional equilibrium between the contending forces.

In planning and constructing the Ypsilanti water works, it has been my aim to harmonize all these elements, and to develop a practical working service, of the highest possible degree of economy and efficiency in all its branches. It is true the natural advantages at Ypsilanti have been highly favorable to this end. Yet plain as have been these vantage points to a correct view, an almost inexcusable blindness has defeated and deferred for years their utilization and the carrying out of this great improvement.

In April, 1889, the people voted, almost unanimously, to bond the city for $75,000, the money to be used in developing a system of water-works.



Section of Elevated Reservoir; Ypsilanti Water-Works.



Plan of Floor Supporting Elevated Tank; Ypsilanti Water-Works.

In the commencement it was deemed best to put on only about 10 miles of street mains, with a small steam pumping plant, and an elevated reservoir.

Later it was found that an excellent water-power, fully equipped for service, was available, and it was deemed best to purchase this water-power and abandon the steam pumping part of the plan.

The adoption of the water-power increased the first cost of the proposed works about $20,000. As the work progressed, and the people began to appreciate the great advantages that would accrue from the improvement, a popular demand sprung up calling for a large extension of the street mains, the result being that an additional $50,000 in bonds was voted, and additional mains were put down, until the total street main distribution reaches nearly 18 miles. This gives Ypsilanti 2½ miles of street mains for each 1,000 inhabitants, which is more than double the average of the cities of the United States having water-works, and makes her better equipped in her public water supply services, in all its branches, than is any other city in the State.

This very liberal provision at the outset has proved wise, and fully justified by the results. The people are more generally satisfied, as the entire city now enjoys the full benefit of the improvement, whereas, with only 10 miles of street mains, as at first intended, only about ⅓ of the city would have been directly benefited.

The most remarkable feature in the development of these works is, perhaps, the astonishing fact that they start from the day of their opening, as a self-sustaining public improvement. The plan adopted in constructing the works will account for this extraordinary send-off for the enterprise. Utilizing our water-power, we brought into requisition a temporary pump, and taking water from the river, filled the mains as fast as laid, the object being mainly to provide water for puddling the back-filling of the trenches, and to furnish fire protective service from the hydrants as fast as set. In 16 days from the opening of the first trench we threw fire streams 90 ft. high, direct from the mains in the heart of the city, ¾ mile from the pumping station, and in 90 days all the street mains were in place, and the city fully provided with a complete and effective domestic and fire protective service. Right here comes in the most remarkable feature of the enterprise. Soon after commencing pipe laying, applications began to come in for permits to tap the mains for water for lawn sprinkling. Very soon this demand far exceeded the capacity of the plumbers to meet, and kept in advance until the close of the season. Between 400 and 500 connections were made before the close of the season, and before the works were completed and formally opened. Had the board been able to keep pace with the demand of the applicants, there would doubtless have been 800 paying connections with the mains before the works were completed and formally opened.

From the first I entertained no doubts as to the complete success of our proposed water supply development, hence we did not wait for the completion of this branch of the work before starting in on other parts of the work, but commenced and prosecuted all simultaneously.

The water-power and buildings of the Ypsilanti Paper Co., located in the southern part of the city were purchased by the city, and the pumping plant located there. The supply well was located about 1,000 ft. from the pumping station, on the opposite side of the Huron River, which, running from north to south, bisects the city. This well consists of a circular caisson, 30 ft. in diameter, constructed of iron and masonry, the sides being impervious, and sunk to the depth of 30 ft., terminating in a coarse stratum of water-bearing gravel.

Fifteen ft. of hard pan, of such tenacity as to require blasting, overlaid this water-bearing stratum. When the water was reached it overflowed the surface of the ground. This water supply is ample in quantity for the utmost requirements of the city, having been tested to more than 3,000,000 galls. per day, and the quality of the water cannot be surpassed.

The pumps are connected with this well by a 16-in. suction main, running under the river in the same trench, and parallel with the 12-in. main. The elevated reservoir is located 1½ miles from the pumping station diagonally across the city. The ground

upon which this structure is built is 103 ft. above city datum.

The reservoir is constructed as follows: First: A circular substructure of masonry, 42 ft. in diameter, and 85 ft. high is constructed. The walls are of Joliet stone laid in cement mortar. The outer wall is in true circular form, 3 ft. 4 in. thick at the grade line, and 2 ft. thick at top or base line of reservoir. There are 3 parallel walls at equal intervals inside, running entirely across and intersecting the outer or circular walls. These walls are each of the same thickness and height as the outer or circular walls. The excavation in which the foundation for these walls is laid is circular in form and 50 ft. in diameter, and covered solidly to the depth of 6 ins. with very rich cement mortar. Upon this are laid the footing courses for the walls above. These courses are of dimension stone, laid in terrace form, each course being 16 ins. in thickness, the first course for all the walls being 6 ft. in width, terminating at grade line in a course 4 ft. in width.

Crossing the wall at top, in parallel courses 2 ft. apart, at right angles with the walls, are steel floor beams 10 ins. in depth, for the reservoir to rest upon, the walls being built up between the beams flush with their upper surface. These beams project 30 ins. outside the masonry all around.

The reservoir consists of a steel tank, circular in form, 40 ft. in diameter, and 27 ft. deep, and rests on the floor beams and walls of the substructure. A 16-in. main connects the reservoir with the street main distribution, and an 8-in. overflow pipe leads to the sewer. This reservoir is entirely inclosed with a structure of wood. This building rests upon a circular plate of steel, bolted to the ends of the projecting floor beams, is circular in form, rises perpendicularly as high as the top of the reservoir, and from this line a dome roof is sprung over the whole, terminating in a cupola with glazed windows in each of its four sides. There is 2 ft. of clear space between the outside of the reservoir and the inside of the walls of the inclosure, and 22 ft. of clear space from top of reservoir to base line of cupola. The cupola will be 250 ft. above city datum, and will be provided with a cluster of electric lights.

The capacity of this reservoir is a little in excess of 250,000 galls., which is 35 galls. per capita for the entire present population of the city, and every gallon of this water is always available for full effective fire service. The full reservoir will furnish 6 effective fire streams, for 6 consecutive hours, without reinforcement from the pumps. This reservoir will be ample to render full service to the city for at least 5 years, after which it can be duplicated on a corresponding summit on the opposite side of the river and city, a central 12 in. force main leading from one summit to the other. This main is already laid. The present force main from the pumps through the distribution, is 12 ins. in size, and runs through the main part of the city on the west side of the river. Five years hence the plan contemplates a duplicate 12 in. main on the east side. The present arrangement will adequately supply all demands up to that time, and the plan when fully completed will be better than if a larger single force main had been provided in the outset.

With the plan fully carried out, the pumping station and the two reservoirs will occupy the three points of a triangle, about equi-distant, with the entire street main distribution inclosed. Under this arrangement we will secure a very high degree of effectiveness in the service, the frictional loss of the water passing through the mains being very small. The street main distribution is so arranged as to give a double discharge fire hydrant at every street intersection. The mains cross the river 5 times thus giving good service to all parts of the city on both sides.

The pumps are power pumps of an entirely new pattern, are triplicate in form, and promise to give an exceptionally high economic duty. A very great saving of expense will be made in the running of these works by water power.

There is water sufficient all the year to operate the pumping plant, and for nine months in the year there is very much more than needed. The city will utilize this extra power to run the electric street lighting plant, which is now operated by steam power. The electric plant is now being placed in the pumping station and will be run by the same power as the pumps, when there is sufficient water, and when there is not sufficient water, by a Corliss engine attached to the same line shaft, being so arranged as to permit of instant change from water to steam, or the reverse. It is estimated that this arrangement will save the city $5,000 per year in running the two plants as compared with running both by steam.

The cost of the Ypsilanti water-works has been a little less than $140,000. Of this, however, $10,000 should be charged to the electric light plant, and $5,000 to the private service development fund. This will leave the actual cost of the water-works at $125,000. The elevated reservoir cost $17,000, which is about 6½ cents per gall. of its contents, or about ⅙ the cost per effective gallon of the naked stand-pipe method of storage, or about ¼ the cost per effective gallon in the inclosed and protected stand-pipe. And this does not take into account the great saving in the operating expense that the elevated reservoir secures to us. This saving of expense alone will repay the entire cost of the reservoir, principal and interest, long before the 30-year 4 per cent. bonds, issued for its construction, fall due. Added to all this, we have the greatly increased effectiveness of the service, which this reservoir insures to us.

The interest on the cost of these works and the current running expenses will not exceed $8,000 per year.

The revenue from private rates alone will exceed this at the end of the third year, and the City Council has only to credit the water-works an exceedingly low rate for fire protective service, to provide a sinking fund that will take care of all the bonds issued for the entire work, long before their maturity, and this without levying one dollar in tax to redeem these bonds.

The transfer of the electric light plant to the pumping station will enable the city to sell several thousand dollars' worth of buildings and machinery belonging to the present plant that will not be needed at the new stand. The city can also sell her two fire steamers, as there will be no further use for them, and the electric plant can be operated at the pumping station for less than one half the cost in its present position.

Before closing, it will, perhaps, not be amiss to say a few words relative to the question of public or private ownership of such public improvements. For myself, I believe the public good should be held as the paramount question always in the projection, execution and operation of such public improvements. In no case should a private corporation be intrusted with the ownership and management (for gain) of a public work, when the protection of the property, the health and the lives of the people are at stake. Every city, every community, should exercise full authority and control over every public work involving these great public questions, and should never grant franchises by which these rights are taken away and given to private corporations.

The chief argument advanced by the advocates of private ownership and management of such public works, is the claim that such works can be constructed and operated more economically by private corporations, than by municipalities. This is not necessarily true, and even if true, it is a trivial surface argument, and totally ignores the deep meaning of the great underlying questions. But it is not true that private ownership and management is more economical.

Let us take the Ypsilanti works to illustrate. Under private ownership and management the private service alone at Ypsilanti would cost the consumers at least $8,000 per year, and the fire service at ¾ the average of other cities in the State operating on the franchise plan, would cost $8,750 per year more, making $16,750 per year that the citizens would have to pay under private ownership. Under city ownership and management, if the same amount is paid each year, it will pay all running expenses, the interest on the water-works debt, and in twelve years, entirely wipe out this debt, at the end of which time the works will bring to the city treasury an annual surplus revenue of at least $12,000. Added to all this, this city has a fire service far superior in effectiveness to that which any private corporation would have given.

In the construction of the Ypsilanti works, no contracts for work were let, everything being done by day labor. This made it much harder for the engineer, but has given the greatest satisfaction to the city, as not one dollar has left the city as contractors' profit, the home labor and tradesmen getting the full benefit of all the money paid out in the city.

As of much interest in connection with Mr. COATS' paper, we publish herewith engravings showing the supply well and several views of the elevated tank, which is the chief point of novelty in the works, and the one most deserving attention from engineers.

The following figures as to the reservoir are sent us by Mr. COATS:

The pressure of the reservoir structure on the cement floor is 2,612 lbs. per sq. ft. The whole load upon the dimension stone footings is 3,870 lbs. per sq. ft. The maximum pressure of the full tank upon its wall bearings is 4,646 lbs. per sq. ft. or 32 lbs. per sq. in.

The following is an itemized statement of the cost of the works:

Supply well	$6,483.91
Elevated reservoir	21,500.00*
Pumps, water-power rights, etc.	37,000.00
Street main distribution system, including hydrants and gates	65,000.00

The total cost of the works as they stand, writes Mr. COATS, including the transfer of the electric light dynamos to the pumping station, has been in round numbers $140,000. Since the completion of the works the city has been offered $250,000 for them as they stand. Comment on Mr. COATS article will be found in a later issue on our editorial pages.

The New Brooklyn Dry Dock.

The new timber dry dock at the Brooklyn Navy Yard, formally opened this week, was built by J. E. Simpson & Co. on their well-known plans, under the charge of Mr. P. C. ASSERSON, Civil Engineer, U. S. N. It is similar to the docks being built for the Government by the same contractors, at Portsmouth, Va., and League Island, Pa.

Briefly described, this dock is built in an excavated basin, is founded on piles, and is lined through out with heavy timbers of Georgia pine; it is closed at the outer end by a floating caisson of the usual type, and is provided with a heavy pumping plant for emptying it.

Work was commenced on this dock in December, 1887, and it was to be completed in two years; but owing to unusual difficulties foundations and pile driving, etc., there has been some delay. The general dimensions are as follows: Length over all on coping, 530 ft.; length over all inside of caisson, 500 ft.; width on top at center, 130 ft. 4 ins.; width on floor at center, 50 ft.; width on floor at entrance, 53 ft.; width at top at entrance, 85 ft.; depth of gate-sill below coping, 30½ ft.; depth of gate-sill below high-water, 25½ ft.; depth at center, 32 ft. 8 ins.

The entire structure is surrounded at a distance of about 25 ft. by 8 in. tongued and grooved sheet piling driven about 45 ft. through a quicksand formation. Within this inclosure piles were thickly driven and their heads then buried in 5 ft. of Portland cement concrete at the axis of the dock, and 6 ft. of concrete at the sides. Lines of piles, four to each, also support the inclined caps which carry the sides of the dock, which rise in steps of 8 ins. at an angle of about 45°. The lower ends of these side caps abut against the floor timbers. The concrete is brought up back of the sides about 6 ft. in height, and ranging from 2 to 5 ft. in thickness; and above this space an impervious clay puddle is carried to the top.

The pumping plant was supplied by the Southwark Foundry & Machine Co., of Philadelphia. It consists of two centrifugal pumps, 42 ins. in diameter, driven by two vertical engines of 28-in. cylinder and 24-in. stroke. These pumps have a capacity of 80,000 gallons per minute, and can empty the dock in 90 minutes when no vessel is in it. The contract price for the dock was $565,892, though this does not include the cost of making connection between the dock and the harbor through the heavy sea-wall. This latter work was done by the Government at a cost of about $30,000. The cost of the adjoining granite dock, only 320 ft. long and built by the Government, was $2,241,000.

*It will be noted that in his paper Mr. COATS gives the cost of the reservoir at $17,000. Probably the larger figure includes land and foundations, while the former does not. —ED.

Greenheart and the Teredo.

The older generation of European engineers, who are not in touch with the iconoclastic spirit of the age, have been shocked to hear of the shattering of an ancient idol. If there was one thing supposed to be sure it was that greenheart timber, a kind of laurel or lignumvitæ, little used here but much used abroad, would withstand the attacks of the teredo but such is found not to be always the case. From a paper published in the *Transactions* of the Institution of Civil Engineers, it appears that the Port Elizabeth Harbor Commissioners had two jetties constructed fron the designs of Sir JOHN COODE in 1878. The seaward ends were made of very excellent greenheart, and it was thought, of course, that all would be well. Lately, however, it was noticed that there were signs of decay in one of the horizontal pieces, and on cutting into it with an adze a terrible state of affairs was revealed. *Nectandra rodiæi* had fallen a prey to the insidious worm, for further examination showed that all the horizontal timbers at low-water mark were honeycombed about an inch deep with the tunnels of the teredo. In the vertical pieces the damage was not so great. Fortunately, the main part of the structure was built of wrought iron, but a timber frame has been placed outside as a fender, and this was next examined. Not only was the teredo found here in vast numbers, but another marine enemy of the engineer, the *chelura terebrans*, had followed it. The chelura does not work in the wholesale manner of teredo, but its operations are of a more scientific character. It gets between the butts and quietly eats away the ends where the timbers join, and in this way will do a maximum amount of damage with a minimum amount of exertion. The teredo and chelura, between them, have put the Port Elizabeth Harbor Commissioners to an additional expense of $125,000.

We may also mention that Sneeze-wood, *pteroxylon utile*, which, although not so well known, has borne a character not inferior to its sister greenheart for repelling the advances of the teredo, has likewise been found to be of unstable virtue. Sneezewood piles of a railway bridge over a tidal stream in South Africa have been so damaged by teredo that they had to be removed and iron ones substituted.

"Worms that Eat Steel."

The following venerable chestnut is still traveling about through the technical press. We have noticed it once before as a curious illustration of the gullibility of man, but as we find it in full in a technical exchange of some prominence we think our readers will enjoy reading it. So far as we know it is manufactured out of the whole cloth, reference to the Cologne *Gazette* and all. The perpetrators of this most successful joke must have derived no little pleasure from it.

For the past two years the German government has been making inquiries into the life, history and ravages of one of the most remarkable worms known to exist. This wonderful creature, whose gluttonous appetite is only satisfied after a feed on common steel, was first brought into general notice by an article in the Cologne *Gazette*, in June, 1887. For some time preceding the publication of the account mentioned, the greatest consternation existed among engineers employed on the railway at Hagen, by accidents which always occurred at the same place, proving that some terrible defect must exist either in the material or the construction of the rails.

The Government became interested, and sent a commission to the place for the purpose of maintaining a constant watch at the spot where the accidents—one of them attended with loss of life—had occurred. It was not, however, until after six months had elapsed that the surface of the rails appeared to be corroded, as if by acid, to the extent of over 100 yds.

The rail was taken up and broken, whereupon it was found to be literally honeycombed by a thin thread-like gray worm. The worm is said to be two centimetres in length and about the bigness of a common knitting needle. It is of a light gray color, and on the head it carries two little sacs or glands filled with a most powerful corrosive secretion, which is ejected every ten minutes when the little demon is lying undisturbed. This liquid when squirted upon iron renders that metal soft and spongy, and of the color of rust, when it is easily and greedily devoured by the little insect. "There is no exaggeration," says the official report, "in the assertion that this creature is one of the most voracious, for it has devoured 36 kilogrammes of rails in a fortnight."

A Novel Wrought Iron Chimney.

The following are particulars of a wrought-iron factory chimney, of a somewhat novel description, which has been built at Creusot. The total height is 279 ft., the diameter 23 ft. at the base and 7 ft. 6 ins. at the top; the total weight being 80 tons, exclusive of masonry foundations. The latter are carried 3 ft. 3 ins. above the ground, and weigh about 300 tons. The shaft was built in successive rings, each 4 ft. 1 in. high, the thickness varying from $\frac{7}{8}$ in. at the base to $\frac{1}{4}$ in. at the top. The nine lower rings were formed of eight plates each, the upper ones of four plates each. The base was encircled by a massive angle iron bolted to the foundation. The eight lower rings were lined with fire brick. The erection of the chimney occupied 70 days, including taking down the flying scaffold. The latter was of a somewhat novel character. It consisted of a central wrought-iron tube 7 ins. in diameter, and provided at the bottom with four wooden cross bars or arms, so clamped that their length could be adjusted to suit the varying diameter of the chimney, and carrying the internal platform. These arms rested on angle brackets refitted to the interior of the plates. The upper part of the central tube carried four cross arms, or jibs, each consisting of a pair of timbers stiffened by raking struts from the central tube. From their outer ends was slung the exterior circular platform. The latter consisted of a pair of angle iron rings, to the outer part of which was riveted a plate iron fence, while the inner was provided with T-iron stanchions. Radial bearing timbers, resting on these rings, and adjustable endwise to suit the varying diameter of the chimney, carried the platform, an annular space being left just sufficient for hoisting the plates. The latter operation was effected by a rope passing over an adjustable pulley fixed to each jib in turn, and carried down a central tube to a snatch block fixed at the bottom of the chimney. As each successive ring was riveted up, two pairs of bars were laid across, by which the scaffold was slung by four jack screws furnished with ratchet collars, and thus raised high enough to take a bearing on the next set of angle brackets. The complete scaffold weighed about 4 tons and the heaviest plate about 8 cwt. The total cost, without foundations, was about $8,000.

An Interesting Novelty.

Mr. J. W. HENSHELL has just returned from Washington, where he has been to have a car coupler patented. The contrivance is one of the most simple of its kind yet produced, and if adopted, all danger of loss of life while coupling cars will be eliminated. Mr. HENSHELL has been working on his invention for a long while and has just brought it to perfection. If it proves a success, as he has every reason to believe, the plant for manufacturing it will be located in Roanoke.—*Roanoke (Va.) Times.*

SEAMLESS TUBE WORKS are now established at Findlay, O., operating under the patents of Mr. CHARLES KELLOGG, with machinery perfected by Mr. WM. HECKERT, M. E. A local paper describes the machinery as working to perfection, producing a 12-ft. tube in 3 seconds, but no further detail is given as to the actual output.

SEAMLESS STEEL TUBES MADE FROM MOLTEN METAL, says the Boston *Herald*, is to be the outcome of a Boston man's invention. No details are given other than that experimental machines built have demonstrated the feasibility of rolling a tube directly from molten steel, iron, brass or other metal. The inventor also claims that he can make compound tubes in the same way by rolling one metal on another. There is a big fortune in the scheme if the thing can be done.

THE STREET DISTURBANCE QUESTION.—The following remarks by the Boston correspondent of a Maine paper have some significance in New York:

"We are now being treated to a sight of the rich, choice soil that underlies Boston's streets. An electric company is now engaged in digging up asphalt and granite pavements that cost $4 a square yard three years ago. Who does own the streets anyway? The best thing that Boston can do is to plant the streets to turnips and move to Hingham."

PERSONALS.

Mr. H. C. IVES has resigned his position as Manager of the Montana Central R. R.

MR. JAMES E. WILLIS, civil engineer, died on May 1, at his home in Cornwall, N. Y., aged 71 years.

Mr. T. W. BURROWS, Assistant Superintendent of the Western Division of the New York Central R. R., has resigned.

Mr. GEO. W. NESMITH, of Franklin Falls, N. H., at one time a Director and President of the Northern Ry., died May 2.

Mr. ROBERT PRESTON has been appointed Locomotive Superintendent of the Western division of the Canadian Pacific Ry.

Mr. W. B. STIMSON, Roadmaster of the Grand Rapids & Indiana R. R., has been made Superintendent of the northern division of the road.

Mr. D. H. NICHOLS, General Superintendent of the St. Louis & San Francisco R. R., has resigned, and Mr. F. E. MERRILL will succeed him.

Mr. A. G. YATES, of Rochester, N. Y., has been made President of the Buffalo, Rochester & Pittsburg R. R. Co., to succeed Mr. ADRIAN ISELIN, JR.

Mr. MARVIN HUGHITT, President of the Chicago & Northwestern R. R. Co., has been elected a director of the Union Pacific, vice Mr. DAVID DOWS, deceased.

Mr. J. M. WATTS, who has been Acting Superintendent, has been made Superintendent of the Toledo division of the Lake Shore & Michigan Southern Ry.

Mr. T. E. MERRILL, Superintendent of the Carthage Division of the St. Louis & San Francisco R. R., will succeed Mr. D. H. NICHOLS as General Superintendent.

Mr. MICHAEL CONNORS has been appointed Roadmaster of the Buffalo division of the Lake Shore & Michigan Southern Ry., vice Mr. W. H. COURTNEY, resigned.

Mr. J. W. MORRIS, of Fort Wayne, Ind., has been appointed Roadmaster of the New York, Pennsylvania & Ohio R.R. His division extends from Dayton to Kent, O., and he will be located at Galion.

Mr. J. C. ULRICH, C. E., for several years Superintendent and Engineer of the North Poudre Canal Co., Fort Collins, Colo., has accepted the position of engineer in charge of the Bear River Canal Co., of Utah

Mr. MILLARD HUNSIKER has resigned his position as Assistant Secretary and General Agent of the Carbon Iron Co., and has accepted a position in the operating department of Carnegie, Phipps & Co., Pittsburg, Pa.

The Secretary of Agriculture has appointed Prof. L. G. CARPENTER, of the Agricultural College, Fort Collins, Colo., as special agent to conduct the investigation relative to artesian wells for Colorado and New Mexico.

Mr. W. A. VAN FRANK, Engineer of Maintenanc of Way of the Western division of the N.Y., P. & O. R. R with headquarters at Galion, O., has been transferred to the Hornellsville and Susquehanna division of the Erie lines.

President NEWELL, of the Pittsburgh & Lake Erie R. R., announces the following appointments: Mr. G. M. BEECH, General Superintendent, vice Mr. ELLIOTT HOLBROOK, resigned; Mr. C. H. BRONSON, Auditor, in place of Mr. E. H. HENDRICK, resigned.

MR. D. D. ROGERS, civil and mining engineer, lately with the Atlantic, Gulf & Havana Ry. Co., has resigned from that position and opened an office in Ocala, Florida, as a mining engineer. He has already made some wonderful discoveries of phosphate deposits, noted elsewhere.

Mr. F. A. HOUSTON has been appointed Superintendent of the portion of the Cincinnati, Hamilton & Dayton R. R. between Indianapolis & Hamilton, with headquarters at Indianapolis, and Mr. J. L. ORBISTON Superintendent of the line between Dayton and Cincinnati, with headquarters at Cincinnati.

Mr. O. W. CLOUGH, formerly Roadmaster on the main line of the New York Central R. R. between Syracuse and Lyons, has been appointed Assistant to General Roadmaster OTIS. The jurisdiction of Mr. M. R. WINFIELD, Roadmaster from Rochester to Lyons, has been extended over that portion of the road formerly in charge of Mr. CLOUGH.

MR. DANIEL E. GIBBENS, late one of the Subway Commissioners, of New York, died on May 2, of pneumonia. Mr. GIBBENS was born in Waltham, Mass., in 1839; was graduated from Columbia College and Law School, and was first private tutor to the son of Hon. ROSWELL P. FLOWER and then private secretary, and succeeded that gentleman as a member of the Subway Commission.

Col. HENRY FLAD has resigned his position as President of St. Louis Board of Public Improvement, owing to his recent appointment as a member of the Mississippi River Commission. While the latter position is a most honorable one, and one for which Col. FLAD is eminently fitted, the city of St. Louis will doubtless regret the loss of his services. It is rare that the head of the Department of Public Works in any city is filled by a man who combines executive ability with the training and experience of an engineer as well known professionally as is Col. FLAD.

Major OTHO E. MICHAELIS, Ordnance Corps, U. S. A., died on May 1 at the U. S. Arsenal at Augusta, Me.,

where he had been in command for the last three years. Major MICHAELIS was born about 1844, and at the breaking out of the civil war he enlisted in the 23d N. Y. Regiment, but was soon transferred to the Signal Corps as Second Lieutenant, and later to the Ordnance Corps. In 1864 he was a First Lieutenant and in 1874 he was promoted to Captain of Ordnance. He was the first to enter this branch of the service without first passing through West Point. Between 1875 and 1885 Captain MICHAELIS was chief ordnance officer in the Department of Columbia and Dakota. He was also stationed at the Frankford and Watervliet arsenals before taking command at Augusta, and was especially prominent in military engineering, upon which subject he published a number of valuable papers. He was promoted to the grade of Major only a few months ago. He was elected a member of the American Society of Civil Engineers on May 6, 1874, and it was in the publications of this society that many of his contributions appeared. The sad loss of two of his children, by breaking through the ice on Dec. 1, 1889, and the shock to his system in his attempt to rescue them, have undoubtedly led to his untimely death, as he has been more or less of an invalid since then. Major MICHAELIS was one of the most progressive officers in the ordnance corps, and his loss will be felt in a much wider circle than that of his family and immediate friends.

PUBLICATIONS RECEIVED.

—*Twenty-fourth Annual Report of the Trustees of the Public Library of Taunton.* 1889. Pamphlet, 13 pp.

—*Thirty-sixth Report upon the Registration of Births, Marriages and Deaths in the State of Rhode Island, for the Year ending Dec.* 31, 1888. Prepared by CHAS. H. FISHER, M. D., Secretary State Board of Health. Pamphlet, 222 pp. Published by the State, 1889.

—*Second Annual Report of the Board of Water Commissioners of Little Falls, N. Y.* Pamphlet, 48 pp. STEPHEN E. BABCOCK, Chief Engineer.

The report mentions slight repairs to the vitrified stoneware conduit, and touches upon the use of flush tanks for sewers.

—*Annual Report, Columbus (O.) Water-Works,* 1889. Pamphlet, 86 pp. A. H. MCALPINE, Superintendent.

The report contains quite comprehensive pumping statistics for 1889, reports for new water supply, with map, and a very comprehensive and detailed table of disbursements for the 19 years ending March 31, 1889.

—*Seventeenth Annual Report of the Newport (Ky.) Water-Works, for the Year ending Dec.* 31, 1889. Pamphlet, 61 pp. C. H. JUNGERMAN, Superintendent.

A table is given showing the receipts from 1873 to 1879, inclusive, from water rates, sale of meters and hydrant branches, miscellaneous and total receipts. Another table, covering the same period, gives the disbursements, construction and maintenance.

—*Annual Report of the Water Board of the City of Malden (Mass.), for the Year ending Dec.* 31, 1889. Pamphlet, 33 pp. SOLON M. ALLIS, Superintendent.

Illustrations show the new pumping station at Eaton's mills, the old pumping station at Spot pond, a 12-in. siphon at Medford St. bridge in process of sinking, a new tank, 75 ft. in diameter, 35 ft. high, with capacity of 1,158,000 galls., a view of the water, and another of the steam end of the new Blake pump.

—*Annual Reports of the Committee on Sewers, the Superintendent of Sewers and the City Engineer of the City of Worcester (Mass.), for the year ending Nov.* 30, 1889. Pamphlet, 21 pp. CHAS. A. ALLEN, City Engineer.

The location, length, size and cost of sewers built in 1889 is given in tabular form Mention is made of the work in progress for the purification of the sewage. A new outfall sewer will conduct the sewage of six precipitation tanks, from which the clarified sewage will pass to Mill brook.

—*Interstate Commerce Commission Proceedings.* Cotton Rates from Interior Stations to New Orleans and Boston.

In this case, which involved most of the principal Southern, Central and Trunk Line railways, the Commission decided against a rigid application of the long and short haul clause, and declared that competition of water carriers might be such as to make the "circumstances dissimilar," and therefore justify the charging of a smaller rate for a long haul than would otherwise be lawful.

—*Thirty-fifth Annual Report of the Water Commissioners to the Common Council of the City of Troy, N. Y., for the Fiscal Year ending Feb.* 28, 1890. Pamphlet, 201 pp. GEO. B. FALES, Clerk; EDW. DOLAN, Superintendent.

Among the noteworthy features of the report may be mentioned: tables of receipts and expenditures, somewhat in detail, for the years 1853 to 1889, inclusive; a table of rainfall by months and years from 1826 to 1889, inclusive, the average for the 64 years being 36.57 ins., and the heaviest monthly average for the period being 4.05 ins. for July; itemized operating expenses by months for 1889, and by years for 1881 and 1889, inclusive.

—*Report on Medical Education, Medical Colleges and the Regulation and Practice of Medicine in the United States and Canada,* 1765-1890. By JNO. H. RAUCH, M. D., Secretary Illinois State Board of Health. Pamphlet, 167 pp. Published by the State, 1890.

This seems to be a very comprehensive report. It contains a separate description of existing and extinct medical schools, arranged alphabetically as to state and chronologically as to dates of organization. The introduction gives the number of existing medical colleges as 126 in the United States and 13 in Canada. Thirty colleges now require, or will after the session of 1890-91, four years of study and three courses of lecture before granting diplomas.

—*Interstate Commerce Commission Proceedings.*—Commutation Tickets.—In this case it was held that a commuter must pay his fare when he forgets his ticket, and the railroad company need not refund the amount.

Rights and Duties of a Railroad Company having Running Rights over Another Company's Tracks.—In this case it was held that the railway company having the trackage right need not do a local business along the line of road if its contract for track use provides to the contrary.

Agreement on Through Rates.—It was decided here that carriers are not obliged to pay charges of steamship lines when no agreement for a through rate exists.

Railway Company's Obligation to Haul Excursion Company's Cars.—Held that a railway is not obliged to haul excursion cars of private companies if it already supplies sufficient cars of this sort. The tracks of a railroad are not a common highway.

Whipple's National Electrical Directory and Electric Reports. Cloth, 6½ x 8½ ins. 502 pp. The Fred H. Whipple Co., Detroit, Mich., 1889.

This volume is one of the many annuals which are now appearing, and has a wide and growing field. The book gives the officers and members of the principal electrical and gas societies and street railway associations, and lists of the following industries: street railways, electrical street railways, gas companies, gas companies operating electric lighting plants, isolated electric plants, telephone exchanges, electric light companies, and finally a classified list of electrical and kindred interests. There should also be mentioned a list of electrical publications.

The "lists" are arranged by States, alphabetically, and contain more than their name indicates. Under street railroads, we have: name of town or city, name of road, length, gauge, weight and kind of rail, number of cars and horses, and finally the officials and the office of the company. Under electric street railways the system is named. For the gas and electric light companies the same general plan is followed, the price per light being given for gas, but not for electric lights, although the capital stock of the electric light companies is given.

All these industries are rapidly growing, and to keep his patrons well informed, Mr. WHIPPLE publishes monthly reports, containing revised lists to date. We take the following from the report for February, 1890, the figures being the total number of the various industries in the United States and Canada, and the totals for both countries approximately on Feb. 1, 1890:

	U. S.	Canada.	Total.
Central Electric Lighting Stations	1,338	80	1,418
Gas Cos.	981	47	1,028
Gas Cos. Operating Electric Lights	249	20	269
Street Railway Cos.	861	21	882
Electric Street Rys.	164	4	168

Criticism may well be made regarding the lack of summaries, but we trust these and other defects will be remedied in the second issue, which we understand from the publishers's announcement will appear June 15. As it stands the National Electrical Directory is the only work which in any measure pretends to cover the electrical field, and when revised and perfected it will be extremely valuable to all interested in the industries described or listed.

TRADE PUBLICATIONS.

—*Water Wheels.*—Illustrated hand-book of double turbine water-wheels. James Leffel & Co., Springfield, O. 126 pp.

This pamphlet contains a description of these wheels, with illustrations and particulars of their use for various purposes. Methods of measuring the flow of water, and tables of power, velocity, discharge, etc., are also given.

—*Machines.*—Machines for bolt heading, upsetting, and general forging. Illustrated catalogue of the Blakeslee Manufacturing Co., Cleveland, O. Size, 9 x 6 ins., 46 pp. The catalogue has tables of weights of iron, proportions and strength of bolts, etc.

SOCIETY PROCEEDINGS.

The American Water-Works Association will hold its tenth annual convention at Chicago, Ill., commencing May 20. Arrangements have been made for transportation on the certificate plan, at two-thirds rate, and full particulars can be had from Mr. J. M. Diven, the Secretary, at Elmira, N. Y. The following papers will be read and discussed:

Laying and Maintaining of Mains, Hydrants and Service Pipes, C. N. Priddy; Contamination of Storage Water on the Pacific Coast, and the Palliatives Resorted to, L. J. LeConte; Simplified Method of Book-Keeping for Water Departments, J. P. Donohue; The Desirable Efficiency of Hydrants in Connection with Water-Works, Edwin Darling; The Merits of the Association and the Work Accomplished in the Past Ten Years, P. H. Linneen; Measurements of Drainage Basins and Flows, Saml. McElroy; The Care of Pumping Machinery and Boilers, Chas. A. Hague; Water Supplies, C. Monjeau; Water-Works Securities, Wm. Reinecke; Taxation of Private Water Companies, A. N. Denman; The Basis on Which Schedules of Water Rates Should be Determined, J. Nelson Tubbs; Waters of the Mississippi River, Wm. Molis; Our Experience with Artesian Wells, J. T. Lakin; Some Observations and Suggestions Concerning Water-Works Constructions, F. L. Fuller.

Liverpool Engineering Society.—The 13th ordinary meeting of the present session was held in the Royal Institution, Colquitt St., on Wednesday evening, April 23d, Mr. Henry H West, M. Inst. C. E., President, taking the chair in the presence of a large number of members.

The adjourned discussion upon Thomas L. Miller's paper, entitled "The Efficiency of Gas Engines," which was read before the Society at their meeting on March 26 last, was then opened by Mr. Joseph Price, Jr., who was followed by Messrs. J. Hargreaves, C. J. Beechey, Ernest R. Royston and others. Discussion, which was exceedingly interesting, was further adjourned to the meeting to be held on May 7.

American Society of Civil Engineers.—The regular monthly meeting was held May 7. President Wm. P Shinn in the chair.

The Secretary announced the death, on May 1, of Major O. E. Michaelis, U. S. A.

In regard to the convention, it was stated that the date would be about June 25. A good list of papers is desired for presentation at the convention.

The paper intended for the evening, on "The Strength of Masonry Arches," had been found to be of too mathematical a character for presentation. Advance copies are to be printed, and the subject will be considered at the convention. Mr. A. Fteley gave an interesting description of a masonry skew arch about 70 ft. wide, 75 ft. long on one side and 110 ft. long on the other side; both faces were on curves of different radii, and were battered, so that there was considerable difficulty in preparing the designs for the ring stones. Mr. Shinn described some railway work, which was apparently of excellent quality, but examination showed that the heavy face stones were only about 6 ins. thick, and the backing was dry. This was discovered as the work began to fail; holes were cut and the backing well grouted with Portland cement grout, thin enough to run, and this remedy proved efficacious. Mr. Cohen referred to masonry for railway work which was purposely built dry, owing to the difficulty of obtaining cement, it being the intention of the engineer to grout the work after the track had been laid. After the road was built, however, the company refused to have this work done, and in consequence a considerable amount of this masonry was destroyed by frost and vibration. Mr. Brush described the underpinning and bracing of the middle wall of a reservoir. Several remarks were made on the cohesive strength of brick masonry, in connection with cases where portions of the foundation had been removed without the arch or pier collapsing.

The following candidates were declared elected:

MEMBERS.

Holland Williams Baker, Civil Engineer, St. Louis, Mo.

Henry H. Carter, Eng. of Const., Improved Sewerage System, Boston, Mass.

Henry A. Herrick, Res. Eng., Washington Water Power Co., Spokane Falls, Wash.

Edward C. Jordan, Civil Engineer, Portland, Me.

Gustave Kaufman, of Ferris, Kaufman & Co., Engineers, Allegheny, Pa.

John P. Kelly, Res. Eng., New York State Canals, Troy, N. Y.

Albert B. Knight, Mining Engineer, Butte, Mont.

Olin P. Leisenring, Consulting Engineer, St. Louis, Mo.

Otto J. Marstrand, Asst. Eng., Brooklyn Elevated R. R., Brooklyn, N. Y.

Albert S. Riffle, Chf. Asst. Eng., Oregon & Washington R. R., Walla Walla, Wash.

Charles W. Staniford, Asst. Surv., Dept. of Docks, New York City.

ASSOCIATE.

Malverd A. Howe, Prof. of Civ. Eng., Rose Polytechnic Inst., Terre Haute, Ind.

JUNIORS.

George G. Earl, Eng. of Sewerage of Americus, Ga. Montgomery, Ala.

Charles E. Fowler, Indiana Bridge Co., Muncie, Ind.

Wm. J. Stewart, Asst. City Surv., Rochester, N. Y.

Arthur C. Wheatley, Transitman, Mexican Pacific Ry. Chiapas, Mexico.

Henry C. Yeatman, Asst. Eng., Mexican Pacific Ry. Chiapas, Mexico.

Albert H. Zeller, Asst. Eng., Merchants' Bridge Terminal Ry., St. Louis, Mo.

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

American Society of Mechanical Engineers. Annual meeting at Cincinnati, O., May 13 to 16. Secy., F. R. Hutton, 64 Madison Ave., New York, N. Y.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, May 14. Secy., J. C. Herring, Wichita.

New England Railway Club, Boston Mass.—Next meeting, May 14. "Length of Rigid Wheel Base Permissible on American Railways for Locomotives, Tenders or Cars." Secy., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

New York Railway Club.—Next meeting, May 15. Rooms, at 118 Liberty St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, May 15. Secy., Clement March.

Engineers' Club of Philadelphia, Pa.—Next meeting, May 17. Secy., Howard Murphy, 1122 Girard St.

American Water-Works Association.—Annual meeting a Chicago, Ill., May 20. Secy., J. M. Diven, Elmira, N. Y.

Western Railway Club, Chicago, Ill.—Next meeting, May 20. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, May 20. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, May 21. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, May 21. "River Pollution in the United States," Charles C. Brown, "Compound Locomotives," A. T. Woods; "Granitoid Curb and Gutter," Otto Schmitz. Secy., W. H. Bryan, 309 So. 7th St.

American Society of Civil Engineers, New York.—Next meeting, May 21. Annual convention, at Cresson, Pa., in June. Secy., John Bogart, 127 E. 23d St.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, June 2. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting June 2. "Municipal Surveys," D. W. Pike. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Club, Cleveland, O.—Next meeting, June 3. Secy., C. O. Palmer, 22 Cedar Ave.

Western Society of Engineers, Chicago, Ill.—Next meeting, June 5. Secy., J. W. Weston, 220 La Salle St.

Association of Civil Engineers, Dallas, Tex. Next meeting, June 6. Secy., E. K. Smoot, Elm and Austin Sts.

Master Car-Builders' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 10. Secy., J. W. Cloud, Buffalo, N. Y.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, June 12. Secy., Olin H. Landreth, Vanderbilt University.

American Railway Master Mechanics' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 17. Secy., Angus Sinclair, 140 Nassau St., New York.

If any reader of this journal knows of one or more well-authenticated instances in which a car has been set on fire in a collision or derailment by kerosene or other oil lamps containing oil of 300° or any other fire proof, or if any reader can learn of such an instance by inquiry among other railway officers, we shall be particularly obliged for a statement of the facts, which will, if desired, be treated as confidential, as respects the place and date of the occurrence. By diligent inquiry, extending over a series of years, we has not been able to learn of a single such instance where the facts were clear and well authenticated. Our recent inquiries have brought information of three or four apparent instances, which we are investigating.

Instances are also desired where cars have been set on fire by accidents to lamps, without any train accident, but less urgently, as these are known to have occurred, and in at least one instance with grave loss of life. It is suggested that the evidence must be very clear to show that lamps were the cause of fire, when stoves of any kind were also in use upon the cars.

It has now been pretty generally accepted by the public that the grinding out of the bearing of the stern propeller bracket, from "causes unknown," was the primary cause of the disaster to the *City of Paris*; the dropping of the shaft ended in breaking it; the starboard engine, suddenly relieved of its load, began to race and the smash followed. But Mr. Gillham, who was a passenger on the ship, denies this theory in a letter elsewhere given, and he has what seem to us very reasonable grounds for his disbelief in any mishap to the propeller bearings previous to the accident. A shaft of the dimensions of those of the *City of Paris*, and driven by the power of that ship, could hardly be 8 ins. out of line for some period of time without the fact being made very evident, not only to the officers, but to the passengers on the ship.

As our London correspondent said in his letter of last week, we land at once in the region of conjecture when we attempt to explain why the bearing wore down in this extraordinary manner. It would be extraordinary, indeed, if this bearing should have worn to the extent stated, and yet leave the inboard bearings still cool and in perfect working order, as Mr. Gillham states. To wear away a gun-metal bushing, 1 in. thick, with a shaft 20 ins. in diameter, means that the shaft is out of line; and this fact should certainly be evident in the other bearings. In the wreck of the engine, shown in an illustration from *Engineering* in our last issue, it is evident that any intelligent or satisfying post mortem is practically impossible. But taking the evidence of eye witnesses, as quoted in Mr. Gillham's letter, it would certainly seem more reasonable to look for the primary cause in the engine itself, and to suppose that the terrific power that smashed the starboard engine expended a portion of its force on the inboard end of the 20-in. shaft, and that the shaft broke from this action at the point where it left the ship.

It is an undoubted fact that on each of the four bearings in the shaft tunnel, the caps were forced off or split and the steel bulkhead at the end of the tunnel was split above the shaft. The two bearings, in the dynamo room are also broken in their caps, and the bulkhead between this and engine room is split above the shaft; the thrust bearings, near the engine, were likewise broken and the caps thrown to a considerable distance. It is difficult to imagine how all this could have followed the breaking of the shaft; but the wreck of the engine is a telling evidence of a mighty inboard force let loose, and the lifting of the inboard end of the shaft by this force would fairly well account for all the rest, even to the breaking of the shaft just at the point where it left the ship, and presented a fulcrum for this lever. We can further suppose that this breaking of the shaft would cause the weight of the propeller to be thrown on the outer end of a short length of shafting, and to wear out the bearing referred to in the later towage of 350 miles to Liverpool. The same force that broke the shaft would split the 3¼-in. steel stern tube. At any event, there are certainly good grounds for further investigating the engine room and its details before we charge a shaft shown to be absolutely sound with being the sole original cause of the mischief, and yet can give no reasons why it should have made all this trouble.

The Brooklyn Bridge situation has been changed since our last issue by a very proper if somewhat tardy refusal of Superintendent Martin to serve on the proposed new Board of Experts. A more audaciously improper proposal than that he should be so appointed to judge of his own plans, has never emanated even from the Board of Trustees. As a substitute, the Mayors of New York and Brooklyn are each to appoint two independent experts, an agreement of three out of four being necessary to a decision. It is very hard to foresee what may finally be done by the Legislature, perhaps nothing; but in any case it is now quite certain that no plan whatever will be adopted, except in pursuance of recommendations by a new Board of Experts. Even should the old Board of Trustees hold over without any legal obligation resting on them to appoint such a Board, they will not now dare not to appoint one, nor to appoint a packed one, nor to disregard and defy its advice when rendered, as they did in the case of the last Board. There is, evidently, some powerful interest seeking to continue the Board of Trustees in existence and accomplish certain private ends through it. What they are we can only surmise.

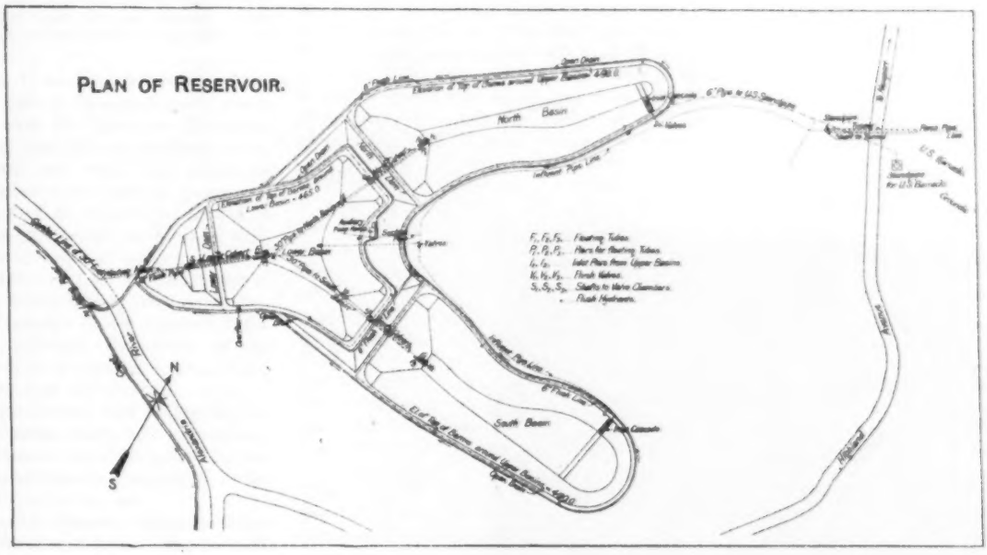
The Director of the New York Meteorological Bureau explains in another column, on behalf of the Signal Office, under which it acts, the apparent mathematical anomaly noted in our issue of May 3, that the percentage of verifications of weather and temperature combined was greater than of weather alone. The explanation is mathematically perfectly sound, as might be expected from its source, but logically it does not seem quite so sound. The expression "weather and temperature combined," as applied to verifications of weather predictions, would naturally be interpreted as meaning the number of instances in which the whole prediction proved accurate. Thus, out of 100 predictions there might be 70 in which both the weather and the temperature were foreseen correctly, a dozen more out of the remaining 30 in which the weather was foreseen correctly but not the temperature, and a dozen others out of the remaining 30 in which temperature was foreseen correctly but not the weather. In this case the natural way of summarizing the facts for public information would seem to be: Weather verifications, 82 per cent.; temperature verifications, 82 per cent.; verifications of weather and temperature combined, 70 per cent. By the Signal Office system—doubtless adopted for some wise purpose, but certainly liable to mislead, more or less—the last percentage also figures as 82 per cent.

Congressional Action on Freight-Car Brakes and Couplers.

Two bills have been introduced in the Senate and are now before the Committee on Interstate Commerce, each of which is intended to secure the very desirable end of hastening the equipment of all freight cars with automatic couplers and power brakes.

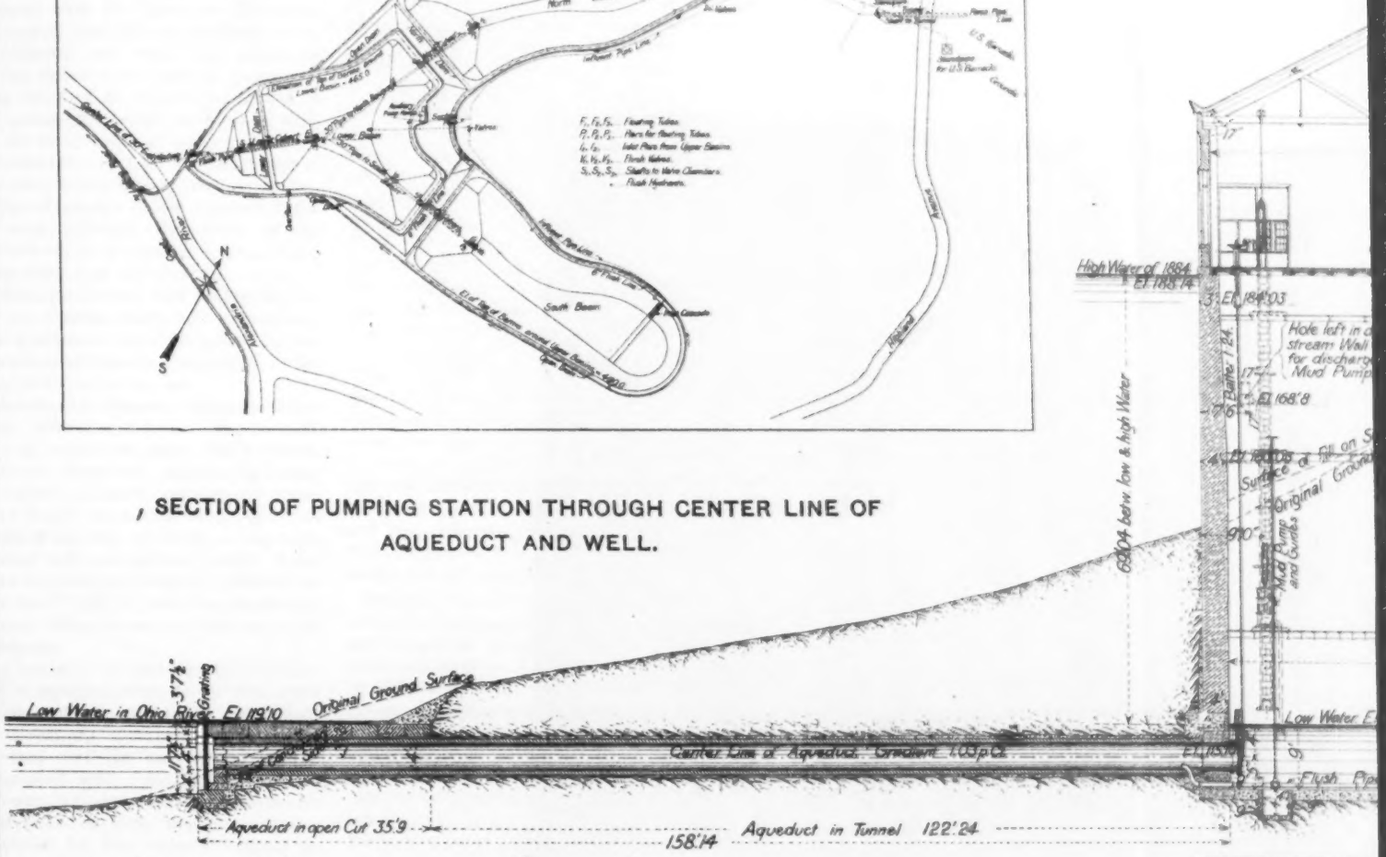
THE NEW WATER WORKS FOR COVINGTON, KENTUCKY.

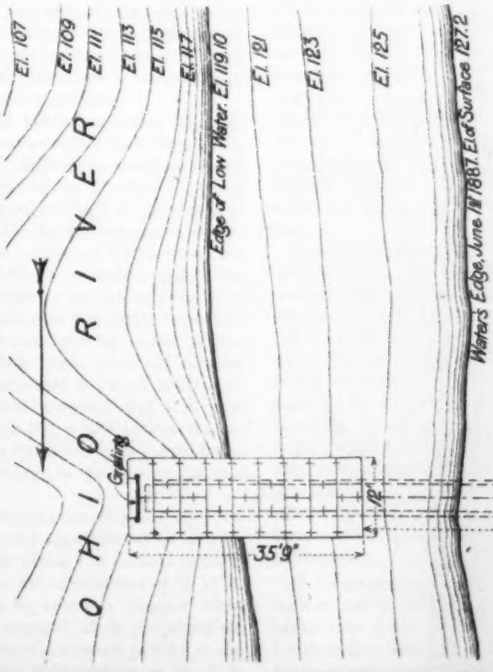
G. BOUSCAREN, CHIEF ENGINEER.



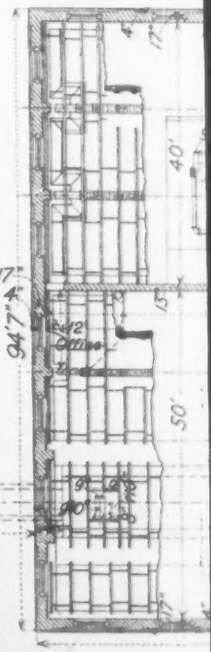
PLAN OF RESERVOIR.

, SECTION OF PUMPING STATION THROUGH CENTER LINE OF AQUEDUCT AND WELL.





PLAN OF PUMPING STATION.



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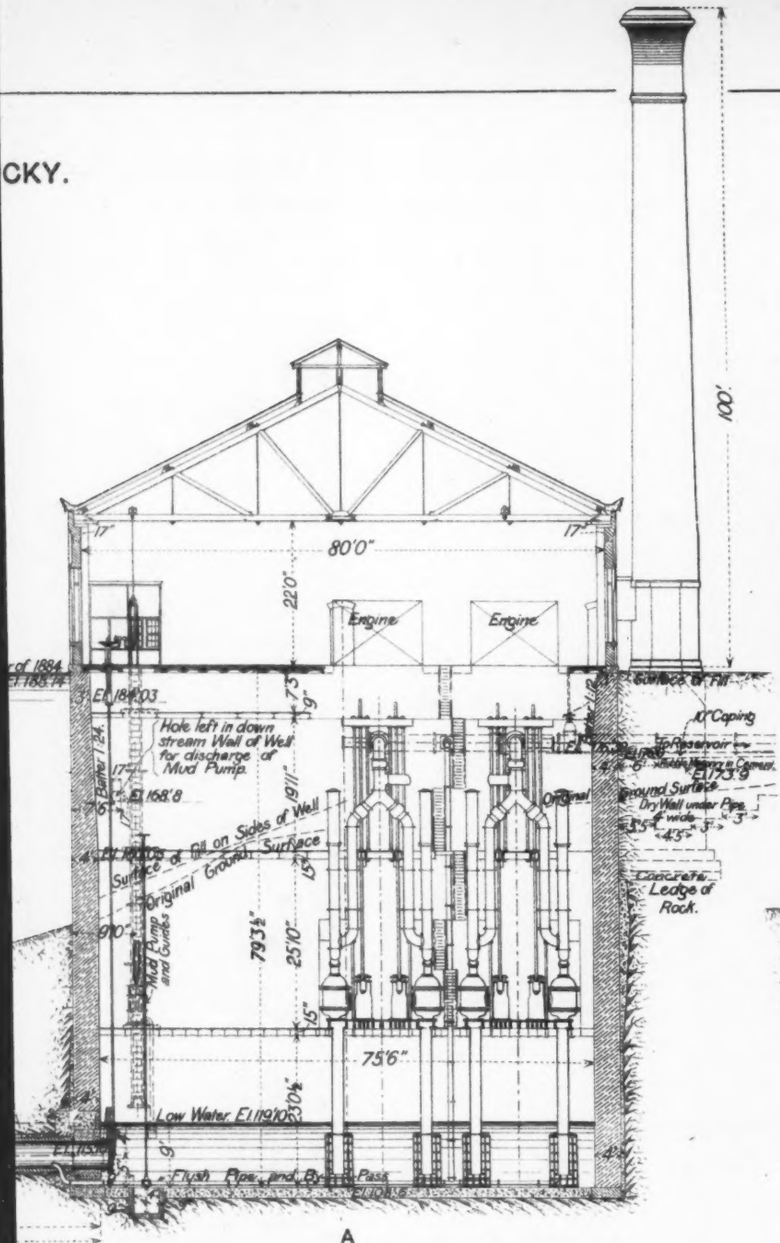

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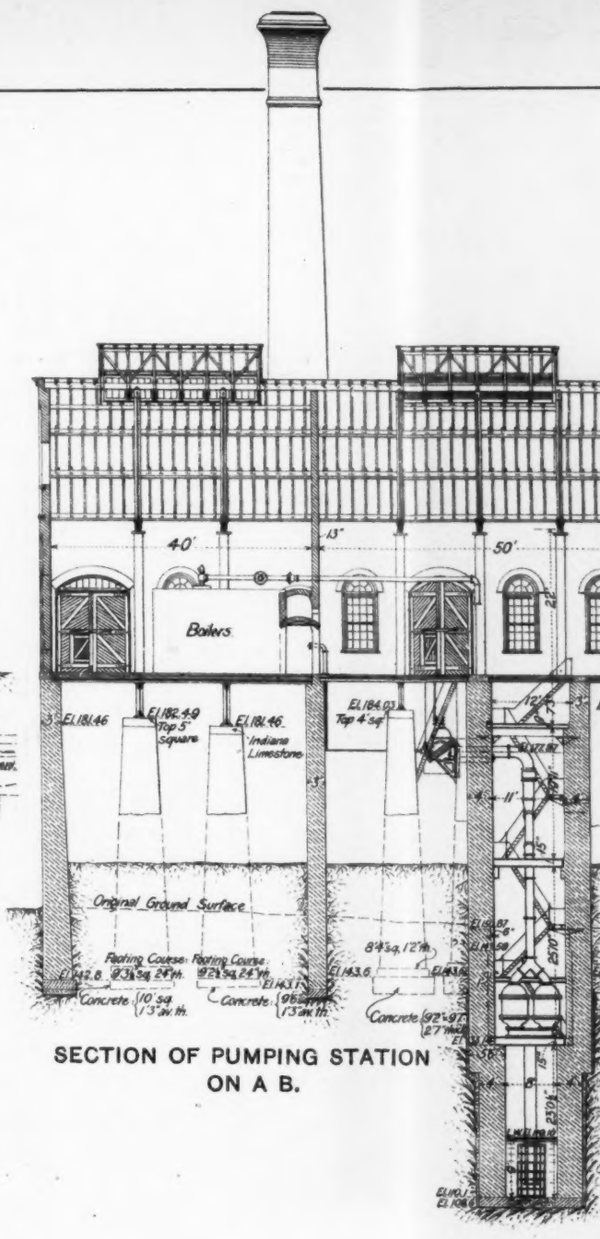
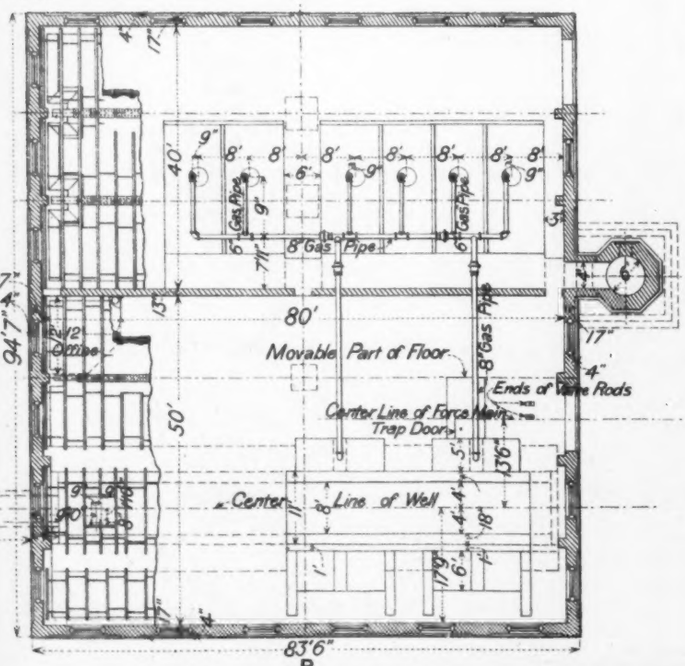
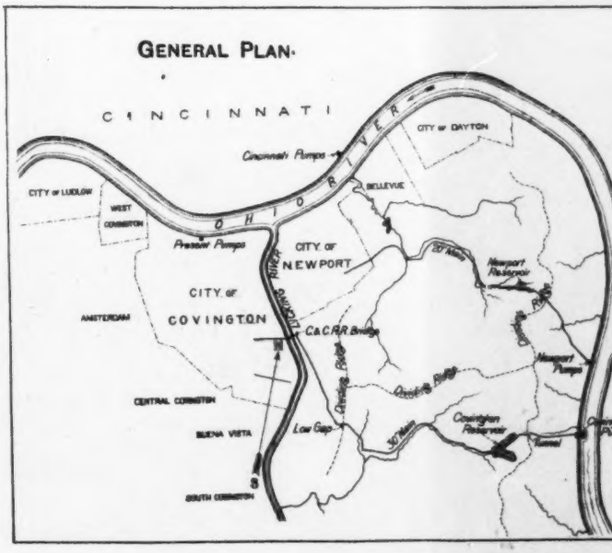
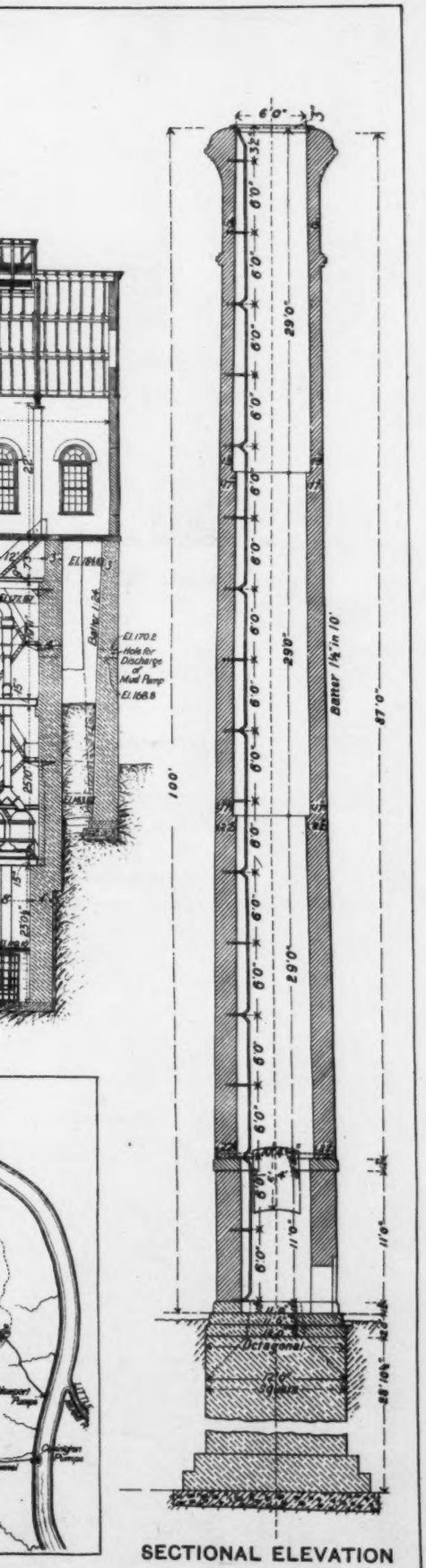


SECTION OF PUMPING STATION ON A B.



B.





SECTIONAL ELEVATION
OF CHIMNEY

CHAS. HART & SONS, LITH., 30 VESEY ST., N.Y.

The bill introduced by Senator CULLOM provides for the appointment by the President of a commission of five persons, three practical railroad men and two men familiar with car construction. The duty of this board is to be:

> To make careful investigation of car couplers in use and of designs for couplers not in use; to fully test all such couplers practically and determine by such investigation and comparison what type or character of car coupler is best adapted for safety and convenience in its use on freight cars.

This commission is to finish this work within one year from the time of its appointment, and is to file a report with the Interstate Commerce Commission stating what type of coupler is recommended for adoption, and what time should be allotted to the railways for putting it in use. Copies of this report are at once to be served on the railway companies, who are to equip all their cars before the time specified, under penalty of $100 per day for every car used without the specified couplers after the date set by the commission. In case the type of coupler chosen is patented, the commission may purchase the patent of the owner, if he will sell for a reasonable sum; otherwise the commission may select another coupler.

After the commission has thus beatifically disposed of the car-coupling question it is to take up other safety appliances, especially power brakes, and make recommendations to Congress as to the device or type best adapted for use.

The bill introduced by Senator Allison provides that after the bill takes effect no company shall put new cars in service or repair cars requiring one or more new drawbars, without equipping them with "safety automatic couplers or drawbars, such as will not necessitate the going in between the ends of the cars to couple or uncouple them, but which will automatically couple themselves and can be uncoupled from the sides of the cars." After Jan. 1, 1895, it is to be unlawful to use in interstate commerce any car not equipped with such couplers.

Concerning brakes, it is provided that all locomotives shall be equipped with driver brakes before Jan. 1, 1892, and that after Jan. 1, 1893, it shall be unlawful to run any train carrying interstate commerce "that shall not have enough cars in such train equipped with some kind of power or continuous brake, so that the engineer upon the locomotive can control the train, as passenger trains are now controlled by the engineer, without requiring brakemen to go between the ends or on top of the cars to use as now the common hand brake." The Interstate Commerce Commission is to collect statistics of the progress in the introduction of all the appliances mentioned.

In section 7 of the bill it is provided that, as soon as any railway has equipped its rolling stock with automatic safety appliances conforming to the specification, it may lawfully refuse to accept cars from connecting roads which do not conform to the standards adopted for its own rolling stock.

This is the substance of the two bills now before Congress, and of which it is stated one or the other is very likely to pass. On general principles it can be safely affirmed that it is better for Congress to entrust to a commission the power of investigating and deciding upon technical matters of this sort than to undertake the work itself. Circumstances alter cases, however, and it is quite evident that the Allison bill, which leaves the selection of the proper type of brake and coupler in the hands of the railways, is greatly to be preferred to the other.

Let us see what would be the effect of the Cullom bill providing for the appointment of a commission. In the first place, the present remarkably rapid progress in the application of M. C. B. Std. couplers would be entirely stopped while the commission was engaged in its investigation. No railway manager would venture to take a single step further in the introduction of M. C. B. couplers until it was definitely known just what type or style of coupler the commission would decide on.

Of course if the President was fortunate enough to secure for the commission thorough mechanical experts, and men competent to take a broad view of the problem, it would be pretty certain what their decision would be; but there are many chances against the appointment of such a commission. It is well understood, of course, that from a hundred to a thousand patentees and owners of patents on various types of automatic couplers would as soon as the bill became a law unite and exert all their influence against the appointment of any man already committed in favor of the M. C. B. standard type. The owners of the multitudinous automatic links and automatic hooks not conforming to the M. C. B. type have never been reconciled to the loss of the money they have spent in pushing their various devices, and they would make a herculean effort to one more chance for securing the coveted prize.

But even supposing the commission to be made up of able and impartial men, everyone would await the result of its labors before proceeding further with the introduction of automatic couplers; and what delay would that cause? Remembering that the law makes it obligatory on the Commission not only to carefully investigate car-couplers in use and designs for couplers not in use, but to "fully test all such couplers practically," it is easy to see that the limit of a year allowed the commission to complete its work would have to be much exceeded. Every inventor will demand that his device be practically tested. The disappointed ones will combine to raise a howl that the commission is partial, unfair, corrupt, incompetent, and has, moreover, been bought up in advance. The newspapers will take up the story, and the people will put implicit faith in it!

Reference has often been made in these columns to the need of a government commission to collect statistics of railway accidents, investigate the more important ones, and make recommendations in accordance with its findings as to the best means of securing safety. In our issue of Feb. 8, 1890, the appointment of a Government Commission on Uniform Railway Safety Appliances was urged, with ample powers to investigate and advise, but no power to compel action. But a commission, such as is contemplated in this bill, with the most absolute powers of dictation, is something without precedent in American legislation, and should be actively opposed by the railways of the country whose interests are at stake. The bill now bears the title, "To regulate the use of safety appliances for cars." Some one should move to amend it by striking out the words "to regulate the use of," and substitute therefor the words "to stop progress in the introduction of," on the ground that the title so amended would more accurately express the effect of the bill when a law.

The Allison bill is far preferable to the other in that it leaves the railways unhampered in the choice of the automatic couplers or power brakes which they will adopt, and in effect only says, "You must not neglect this matter any longer. Adopt whatever you find best, provided it is safe." If the car-coupler question were in the chaotic state it once was, such legislation might do more harm than good; but the question has been thoroughly settled by the railways that the M. C. B. standard coupler is to be the standard for American practice. The Allison bill would have the effect of greatly accelerating the progress in the introduction of this coupler and the application of air brakes.

If Congress is to enact any law on this important matter, and it cannot be denied that the humanitarian side of the question presents strong reasons for its action, Senator ALLISON'S bill seems to be a commendable measure. It is true, indeed, that it establishes a new and dangerous precedent for Congress to interfere in technical matters of this sort, and one which may lead to trouble in the future. At the same time there are State laws by the hundred on matters regulating the details of corporate activity. It is universally acknowledged that in this case State legislation is more likely to result in harm than good. The only recourse, therefore, is to Congress, and it can scarcely be doubted that that body has power to act in the case.

Details of the Allison bill doubtless need some amendment, especially the time allotted for the equipment of the cars, which is almost certainly too short. Section 7 of the act enables the railway companies which have already made heavy expenditures in introducing the M. C. B. coupler to exert a strong influence toward similar action on the part of their connecting lines, and is a very commendable feature. More rapid progress in the introduction of the coupler will be especially for the benefit of the railways which have already a large percentage of their cars equipped with it.

Before the close of the present year, if no check is put on the current rate of progress, it is pretty certain that 10 per cent. of the freight cars in the country will be equipped with M. C. B. automatic couplers and air brakes. The question of what coupler and brake is to be used on freight cars has been decided by the authorized representatives of the railway companies, and government interference to open the question anew, and take it from the hands of the railways who are vitally interested in its correct solution, would be a great wrong. The Allison bill, on the other hand, leaves the railways unhampered in their work of reform. It only demands that old fogyism and false economy shall not delay the introduction of these appliances, now that they are decided on.

Many corporations are now actively pushing the reform; but others, it must be said, are paying little heed to it. To promptly secure that safety of the lives and limbs of railway employés, which is now feasible, all railway companies should begin at once the equipment of their rolling stock. They must begin sooner or later, and no valid reason for delay can be urged. It is to oblige prompt action on the part of these delinquent corporations, who fail to realize their proper duty to their employés, to the public and to other railway corporations, that legislative action is called for.

Conventions of Water-works Superintendents.

The Tenth Annual Convention of the American Water-Works Association is to be held at Chicago this year, commencing May 20, and the President very appropriately takes this occasion to review the growth of the association within the last decade. Commencing with a membership of twenty men interested in the improvement of then existing methods of operating water-works, the lists of this association now include over 300 names, and among these names are those of the brightest and most progressive water-works men of the day.

The annual meetings have been a most encouraging success in bringing together men interested in a common and most useful purpose, which, as well set forth in the constitution of the association, is —"the exchange of information pertaining to the management of water-works, the mutual advancement of the interests of consumers of water and the suppliers of material, and for the purpose of securing economy and uniformity in the operation of water-works." This purpose has been carried out by the reading of useful papers on subjects of interest, and, doubtless more than in any other way, by the opportunity thus afforded to live men from widely scattered sections of the country of discussing matters of mutual interest and comparing experiences in the convention and out of it.

Superintendents of water-works, unlike engineers, doctors or the clergy of a town, are practically alone in their work; they are usually remote

from others similarly engaged, and are left much to their own resources and such teaching as past or present experience may afford. They are busy, practical men; too much occupied, as a rule, with the duties of their office to devote much time to the literature of water-works operation, even did such exist in any satisfactory quantity, which it does not. But in the operation of water-works, in their economical management and in what may be called the practice of water-works superintendents, there is room for great improvement; and it is from such meetings as the American and New England associations have inaugurated that the most rapid and efficient progress in this direction is to be expected.

At such meetings the water-works superintendent is no longer alone; he is surrounded by others not only engaged in a like occupation, but who have first of all the advancement of a common cause sufficiently at heart to induce them to sometimes travel a thousand miles or more for the purpose of gaining or imparting knowledge; he there meets energetic, practical men, with a keen interest in advance in water-works practice, and who are assembled together with the honest purpose of not only aiding each other but of benefiting the communities they severally serve. With an aim so unselfish, and with prospective benefits so great, the one surprising fact is that, with the great number of our existing works, the attendance of superintendents should be comparatively small. One substantial reason for this may be found in the fact that the average salary of superintendents of water-works is not an extravagant one, and many who would otherwise go naturally hesitate when the expense of attendance is a personal one.

When it is considered that the object of these meetings is purely impersonal, and that the knowledge gained there is to be used for the good of a whole community, and not for any individual, it would be not only a proper but a very sensible action for the heads of water boards and companies to send their executive officer to these meetings and to pay all expenses. In fact, it should be the duty of such boards to insist upon the presence of their superintendents, and to require from them a careful report upon matters of interest to themselves relating to the management and the more economical operation of their works. There is money in such a course, whether the works belong to the public or to a private company, and the gain in practice is only measured by the ability of the superintendent to profit by what he learns at such a gathering.

There are now nearly 2,000 water-works in the United States; and while it is too much to expect that each of these could send a representative to a meeting somewhere once a year, there should certainly be twice 300 men among them who could spare the time required. If the boards and water companies take our advice, and at least share the expense of such attendance, there would be at once a most decided gain in convention membership. As to the return to the community for such outlay, the character of the papers read and discussed at these meetings is a sufficient index. Taking the programme of the Chicago meeting as an example, we find the following among other topics for presentation: Laying and maintaining mains, hydrants and service-pipe; simplified method of book-keeping for water departments; the care of pumping machinery and boilers; desirable efficiency of hydrants in connection with water-works; water supplies: water-works securities; taxation of private water companies; the basis of schedule rates; experience with artesian wells, etc. These are all most profitable subjects for discussion; and the profit of their application to practice belongs to the community wise enough to have a live representative present. These papers are written by men who know of what they speak by virtue of years of experience and a careful study of the practice and experience of others, and their value lies in being founded on practice rather than on theory.

But aside from the formal papers, there is great profit in the direct contact between men engaged in a like occupation. Nearly every superintendent has some difficulty, great or small, to overcome in connection with his works; the remedy is one probably that is not treated of in books on hydraulics, and it is beyond the skill or experience of the individual. It may be a delicate matter to put his trouble on paper for public discussion; but the superintendent can there meet or make a friend; and, perhaps, a short talk with a more experienced man may enable him to solve the problem. If, by putting into practice the knowledge thus gained, coal is saved in pumping, or any other economy follows in the several departments of his works, the superintendent may gain in reputation and the esteem of his masters, but the solid gain in dollars belongs to the community or to the company employing him.

We would repeat, then, that there is much profit in the association of workers, such as are gathered together at the meetings herein referred to; and to an increased interest in these meetings by both superintendents and those employing them we must look for all practical advance, improvement and economies in our water-works practice. The subject is one worthy of the most careful study of all connected with it, for it is one representing the investment of nearly $500,000,000 in the United States alone.

The City Engineer's Department of Providence vs. Politics.

Strange news comes from Providence, R. I., regarding the proposed consolidation of the Engineers' Department of that city with the Department of Public Works. A bill effecting this change has been quietly prepared, sprung upon the Assembly and pushed through by a clique of interested politicians, against the earnest protest of the City Councils and the citizens of Providence. The one end in view is undoubtedly to get rid of City Engineer SAMUEL M. GRAY, and to thus obtain control of the execution of the improved sewerage works and the expenditure of the money involved.

The City Engineer's Department of Providence has been justly held up as a model among engineering departments for many years, and its efficiency and generally excellent organization has been solely due to the high executive and professional ability and to the official integrity of Mr. GRAY, who for 18 years has held the office of City Engineer. His methods of performing his duty as an engineer and a public officer have naturally made him enemies among men who believe that the affairs of a great city should be so run as to benefit those in power, and that the interests of the community in general are not alone to be considered. There is a semi-defunct Department of Public Works in that city that finds itself very seriously handicapped in its actions by the honesty of a man who very properly had much to say regarding the manner in which public works should be executed; and finding this man too strongly entrenched in the city he has so well served for many years, this Department and its supporters find means for convincing the Assembly that a transfer of power into their hands is a profitable thing for all concerned.

The city of Providence not only did not ask for such a radical change in existing control, but it had actually protested againts any change through the better class of its citizens. The Assembly, by its improper interference with the local government of the city, will probably have an account to settle with these citizens. It has aided a local city faction in an attempt to get rid of a well-tried officer, an engineer who by years of conscientious work has made himself thoroughly familiar with every need of the city, and who, better than any other man, can carry out its public works to an honest and satisfactory end. It has done this on the eve of an extensive change in the sewerage works of Providence, and would force the citizens to take the chance of finding the expenditure of the millions of their money involved in the execution of this work put into the hands of inexperienced officials, and made to do duty as political capital, with all that these words imply.

The men who have succeeded so far in manipulating the Assembly of Rhode Island have certainly shown no regard for the rights or the wishes of the taxpayers of Providence; and taking their past record with regard to the city engineer's department as an earnest of their future methods, the city of Providence is likely to pay dearly for its change of officers. For a long tried and most efficient organization, they are to have a new administration founded upon a garbled and hastily prepared law, which made no pretense of considering the merits or details of the new situation. For a long time to come it would be a case of throwing both pilot and compass overboard, and the erratic navigation that is likely to result, in affairs municipal, is the least dangerous of coming experiences. If combined with the mishaps incident to inexperience, the department is to be absolutely controlled in the interest of politics and individuals, the mischief in store can be better imagined than foretold.

As to the proposed removal of City Engineer GRAY, as an individual, we can only protest in the interest of all that tends to take the position of the engineer out of the realms of municipal politics of the present day. Under its former laws Providence stood pre-eminent among American cities in its recognition of the proper duties and powers of the city engineer, and the very satisfactory manner in which its public works have been conducted for years testifies to the wisdom of the law, and proves that with a good man at the head the interests of the whole community are so best served. It was the one city that gave its engineer absolute control of its engineering works, and then held him strictly responsible for the manner of their conduct and execution. This method of proceeding was the more remarkable, because in nearly every other large city the political powers have made the engineer simply a servant of the political head of a department of public works, to be appointed and removed at the pleasure of his master.

An engineer holding office under men of the type too commonly invested with the appointing power at the present time, is seriously handicapped in the performance of his duty. Supposing that a thoroughly competent engineer is secured under this system, which is by no means always the case, every act of the engineer must be submitted for approval to a master who is not an engineer himself nor in sympathy with the methods of engineers. Continuance in office practically means submission to the views of his official head, whether these be proper or improper; and a weak man may often yield, at the ultimate cost of his professional reputation and to the immediate cost of the community nominally dependent upon his skill and experience for the proper execution of its public works. The fact of the matter is, no city can afford to go backward in the proper control of its engineering works; and Providence, that has so long stood almost alone in putting this control where it belongs, will bitterly regret the act that changed its well tried laws in this respect.

Notes by Rail.

[EDITORIAL CORRESPONDENCE.]

NATURAL GAS AT PITTSBURG.

A general impression has gone abroad that since the general introduction of natural gas in Pittsburg that city has forfeited its right to the title of the Smoky City. It is pretty certain, however, that before many years it will have as good a claim as ever

to that title, even though Chicago promises to be a formidable competitor for the doubtful honor. The use of natural gas in the Pittsburg district promises to rapidly decrease. At almost every place where I found natural gas in use under boiler furnaces, I was told that it was the intention soon to go back to coal. Prices of gas have risen until it is more expensive than coal for large plants, but a worse fault still is the decrease in pressure, which has made it necessary to sometimes shut down for a day or two works dependent on gas. Of course, when a number of the largest works abandon the use of gas the remaining consumers will have a better chance. It seems to be the general opinion that the remaining supply ought really to be saved for household use, where its advantages of cleanliness and convenience are so great.

Probably one of the greatest advantages arising from the use of natural gas is the impetus it has given to the introduction of gas fuel. At present prices of natural gas it is generally said that producer gas is quite as cheap to use. The advantages of gas fuel for all metallurgical work are so great and are now so well understood that producers are pretty certain to be put in in very many places when the natural gas supply is abandoned.

This use of producer gas may do something to delay the increase of the smoke nuisance, but its effect will probably not be sufficient to offset the continual enlargement of works and the increase in the amount of coal burned. It seems a pity to have such pieces of architecture as the courthouse by RICHARDSON and the new Carnegie library in Allegheny blackened by grime until they look like a building in an old London street, or, indeed, like the older buildings in Pittsburg, but it seems probable that this will yet be the case.

BRIDGE BUILDING AT PITTSBURG.

The bridge works at Pittsburg best known among engineers is the Keystone, where some of the largest bridges in the country have been built, and which was a pioneer establishment in the building of iron bridges in this country. Among the men who in their younger days toiled over drawings and diagrams in the office of the Keystone Works are the heads of the engineering department of the two wealthiest railway corporations in the country, and others who now stand in the front ranks of bridge engineers.

The great number of blast furnaces and steel works in the vicinity of Pittsburg require a vast amount of work on repairs and extensions, which can be well handled by the forge and plate shops of a bridge works, and a considerable proportion of the time of the Pittsburg shops is spent on this sort of works. At the Keystone Works eight large hydraulic cranes were being built for the Homestead Steel Works of Carnegie, Phipps & Co., to handle ladles of molten steel.

Two heavy girders for the new San Francisco City Hall were just being loaded on the cars. They are 105 ft long and 65 ins. deep over all, with a clear span of 100 ft. and a web thickness of $\frac{1}{2}$ in. Their total weight is 65 tons each. Four cars are required for the shipment of each, the girder being supported on blocking at the center of the end cars, and the two intermediate cars acting only as idlers.

Another piece of girder work now in the shops is the superstructure of the Alley Elevated Railway in Chicago, a half mile of which was rushed out in a very short time a few months ago, as it had to be erected before a certain date to keep the franchise from lapsing. The last great bridge to be turned out of these shops is the Ohio connecting bridge for the Pennsylvania R. R. Co., across the Ohio River at Brunot's Island, about 2 miles below the junction of the Allegheny and Monongahela rivers. The superstructure is now being erected.

The large hydraulic testing machine at the works is being rebuilt, and will have a capacity of 800,000 to 1,000,000 lbs., with a hydraulic pressure of 3,800 lbs. per sq. in. The eye-bar pulling heads for this machine are 24 ins. in diameter and 6 ins. thick, and takes a pin 9 ins. in diameter.

The most novel things of all at the works, however, are two old Revolutionary cannon, bearing the stamp of GEORGE III., which are set on end, and form the cylinders for a hydraulic accumulator, working at a pressure of 1,200 lbs. per sq. in. A more literal exemplification of the beating of swords into plowshares and spears into pruning-hooks is rarely furnished. It is, indeed, a strange example of the changes which a century has brought. These old guns were molded and used in the attempt to subjugate England's American colonies. To-day these same weapons are in use at a place which at that time was far in the wilderness, to help fight the warfare of modern competition, in which these American colonies and Great Britain are two of the chief contestants.

Another long-established bridge works not far from the Keystone is the Shiffler, named in honor of one of the pioneers in iron bridge building in America. The works are much smaller than the Keystone, but a new blacksmith shop is soon to be built which will somewhat enlarge the capacity of the works. Two portable pneumatic riveters were in use here, and seemed to do excellent work, except that they were a little slow in operation.

Most of the work turned out here is on railway bridges. The structures on the line of the Richmond, Nicholasville, Irvine & Beattyville R. R., in Kentucky, are now being built here. Considerable architectural work is now done here also. A recent contract is the iron work for the new Metropolitan Opera House at St. Paul. A large proportion of the output is of mild steel, and the company prefer to use it wherever their customers will permit. The works, which were formerly owned entirely by Mr. J. W. WALKER, have recently been transferred to a stock company, Mr. WALKER, however, holding still a large proportion of the stock.

The Pittsburg Bridge Works is a more youthful establishment than the two already mentioned and handles a somewhat different class of work from either of the preceding, its specialty being highway bridges. Railway and architectural work is also taken, however. A contract of 600 tons for the Iowa Central Railroad was completed a few weeks ago. Although heavy work is not a specialty as at the Keystone Works, some good sized pieces have been turned out. Some girders built last year for the P., F. W. & C. were 79 ft. span. The facilities for heavy work are to be increased by the addition of some new machinery. A heavier hammer for the new forge shop has already been ordered. This shop, which is to be put up this summer, will be 50 × 120 ft. in size and two stories high.

The main shop of the works is so arranged that the material—plate, sangles, channels, etc.—enters at one side and moves continuously through the shop, passing first to the punches, then to the riveters and is finally delivered completed at the opposite side of the shop. The main shop has now a capacity of about 500 linear ft. per week. A 100 ft. span bridge can be built complete in 10 hours.

The works have adopted milling cutters for finishing abutting surfaces of square ended compression members, and find them superior to the rotary planer generally used, both in character of work and cost of operation.

LOCOMOTIVE WORKS AT PITTSBURG.

The firm of H. K. Porter & Co. has built up a wide reputation in its specialty of light locomotives for use about mills, mines, steel works, and by contractors. It is not generally realized how extensive is the use of these small locomotives, but the number of machines turned out by this firm alone now stands at between 1,150 and 1,200. The demand is increasing, on the whole, although the dummy engines or street motors, which formerly constituted a considerable proportion of the output, are called for but little now, as cable and electric roads are driving them out.

An engine recently turned out for the Black Hills & Fort Pierre R. R. in Dakota is to climb 116 ft. grades and run around curves as sharp as 110 ft. radius. Among the engines which I found in the erecting shop were a plantation locomotive for Cuba, a mine engine, 24-in. gauge, 5 ft. high over all, with 6 × 10 in. cylinders, for the Brewer Mines in South Carolina; one of ¾-in. wider gauge, for the Lorillard Brick Works, near Keyport, N. J., and an engine for the Talladega, Ala., Iron & Steel Co.

In building these locomotives, which have often to go where tools for repairing are few and small, the plan adopted is to make everything to standards and carry in stock a sufficient amount of the extra parts generally needed for repairs to be able to ship them at short notice.

These light locomotives are almost always built with saddle tanks, as they are used for what corresponds to switching service on an ordinary railway. Brakes are generally worked by hand, except on the largest sizes.

On one of the engines fitted with a steam brake was an excellent device in the shape of a bracket below the cylinder to catch the drip and divert it to one side so that it would not drop on the rail; of course, this is a matter of much greater importance on a light switching engine than on an ordinary type engine.

It is a queer instance of the slowness with which the mass of mankind moves that it is still necessary to apply pumps to most of these locomotives. Often they are placed in charge of workmen who have never seen or heard of an injector. The company, however, applies injectors wherever they will be accepted, not only on account of their smaller first cost but their greater durability and freedom from accident.

Milling machines are largely used in the machine shop, and they turn out the accurate work necessary where the interchangeable plan is pursued in a very satisfactory manner. The inside of links is finished with the milling tool, but for the outside, where a smooth finish is all that is wanted, a rather novel application of emery is made. A rubber tube coated with emery is put on a high-speed mandrel, and the work is passed over it. In this way the work is dressed smooth without any chattering, and the tool fits itself to the inequalities of the work, grinding off no more than is needed to give a smooth finish.

It may interest some engineer who is distrustful of steel to know that it is used here not only for boilers, fire boxes and tanks, but for most forgings. Iron is used for frames merely because of the facility with which it can be welded.

At the Pittsburg Locomotive & Machine Works I found the present quarters well filled with work, and a large and important improvement nearly completed in the shape of a new boiler shop 275 × 120 ft., which will have a capacity when finished of one locomotive per day. This shop has a high monitor roof which gives an excellent light. The floor is of wood and concrete. The site was levelled off and stringers of Georgia pine 6 × 8 ins. were laid about 3 ft. apart. The space between them was filled with concrete to a depth of 6 ins., composed of 1 part Saylor's Portland cement, 3 parts sand and 5 of broken stone. On top of the stringers was laid a 3-in. beech floor.

A Sellers 20-ton girder crane, driven by a tumbling shaft, spans the central bay of the shop, and can be traversed at a speed of 200 ft. per minute. A novel feature in its arrangement is an automatic stop at each end, so that if by any accident the crane should be started with no one on the platform, it will be reversed at each end of the track, and made simply to travel back and forth until the machinery is stopped. The rack by which the crane traverses itself is put on the side of the longitudinal timber instead of on top, so that a bolt or rivet tossed up from below cannot lodge in the rack and cause breakage

As the capacity of this boiler shop is larger than that of the rest of the works, it is expected to do considerable outside work beside locomotive building. This is also the case with the foundry, which now does a large amount of outside work. A pneumatic molding machine is in use here for most of the small castings, and gives excellent satisfaction. The core-making room is in a pit about 10 ft. below the general level of the foundry, and so does not obstruct the light.

Among the new locomotives in progress were 5 consolidation engines for the Pittsburg, Fort Wayne & Chicago Ry.

(TO BE CONTINUED.)

Notes and Queries.

E. D. writes: "In reply to query of W. V. S., April 26, the following pamphlets on foundations are of much value: "Foundations," by Francis Collingwood, a lecture delivered at Cornell University, Feb. 8, 1889; "Foundations in Compressible Soils," Richard Delafield, Corps of Engineers, U. S. A., 1868; "Foundations," by Wm. Bryson, Paper No. 7, Civil Engineers' Club of the Northwest, about 1882.

I. A. S. inquires as to the best practice in estimating the amount of board measure in structures built of *round logs*. We would be pleased to hear from some of our readers better posted in similar measurement than we are.

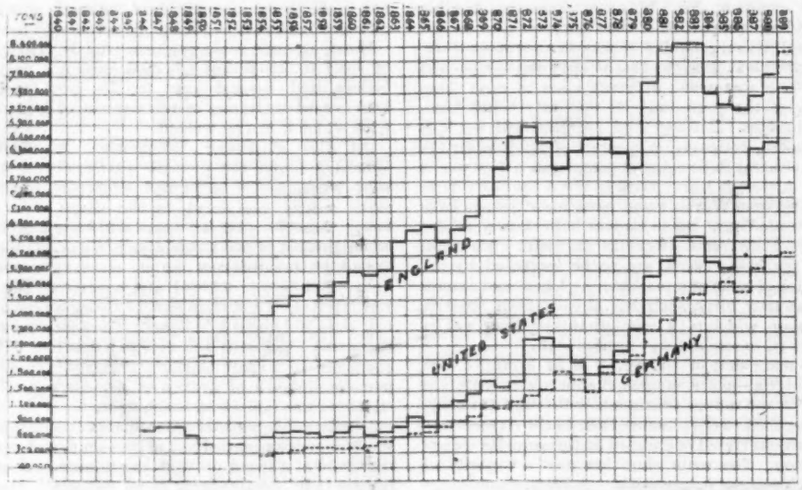
CORRESPONDENCE.

Pig Iron Production Since 1840.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: There seems a substantial unanimity between us that during the past 50 years our iron production has had a set back, but there is a decided difference as to its commencement and duration. A profile, which is submitted, showing the production during the years for which there seems to be undisputed data, may give a better view of the facts than a table. Up to 1854 reliance has been placed on Mr. SWANK'S figures, and after that date on those given by Mr. JEANS, as referred to in your issue of the 12th inst. The German production has been added as a matter of comparison. The English make for last year is as estimated by Mr. JEANS.

You will remember that I stated "The paralysis of our iron production for 1847 to 1861 can only be explained by a reference to our fiscal legislation." It will be noticed that we were apparently holding our relative position as iron producers up to 1847, from that we wabbled painfully and downwardly until 1861, when instead of being about a million tons apart from Great Britain, we were three millions. This, you think, eliminating fiscal legislation, should be ascribed to a frightful period of political uncertainty and disaster. But secession was not expected until after the commencement of BUCHANAN'S administration, the fiscal legislation of 1857 having been the first step in open preparation for it, and during the period under consideration, 1847-61, which is asserted by some to have been the most prosperous in our history, we produced 697¼ millions in bullion. It was, however, a frightful period of economic disaster, with soup tickets given to unemployed men in New York during the winters of 1853-4 and 54-5 and laborers struggling for an opportunity to work a day of 12 hours for 80 cts. on the Central Park, in the fall of 1858.



Pig Iron Production for 50 Years, 1840-89, of England (*i. e.* Great Britain), United States, and Germany.

The interference of internal revenue taxes with our production up to 1875 has been referred to, and the prostration which followed an adverse balance of trade amounting to over $1,500,000,000 is still fresh in the memory of most of us. Some of this immense balance was settled by the exportation of bullion; about 74 per cent. of our production of $1,644,850,000 having been exportod between 1847 and 1875. Some was settled by the surrender of bonds bearing from 6 to 10 per cent. interest, which, like our government bonds, cost the buyer about 40 in gold. The interest and principal has been paid at par, and although we have since achieved a favorable balance of over $1,600,000,000 the other sum has been compounding against us for 15 years.

The noticeable lack of the same rate of increase in the German pig iron production since 1879 as in the United States is due to the preponderant influence of the German professors who, at that time of tariff revision, insisting on what they called untaxed raw material, secured a duty of only $2.45 per ton. German iron industries now depend for their raw material on traders, who have never failed to twist their rivals when opportunity offered, and their distress is now being referred to as an argument in favor of free raw material.

It is, of course, possible to any one to count the years of paralysis, during which we not only decreased our production of iron but of nearly all other manufactured products, as part of 50 years of progress, but the result arrived at will approximate in value that reached by averaging grades. It seems to me that valuable knowledge can only be acquired by noticing the fluctuations and studying their causes—a proceeding which may give a classified body of facts rather than two or more isolated facts.

EDWARD P. NORTH.

[Our correspondent's diagram is certainly interesting, whether or not one accepts his deductions from it. This discussion is drifting into a semi-political field, which is outside of the province of this journal. —ED. ENG. NEWS.]

The Shaft-Bearings of the "City of Paris."

PARIS, France, April 25, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Since the steamship *City of Paris* has been placed in dock and many of the broken parts of the starboard engine removed, and other parts changed in position, and the crank and a portion of the shaft exposed, the owners have furnished photographs to various journals illustrating the condition of the engine after these changes were made.

In the photograph may be seen the piston rod and shoulder or collar referred to in a former letter, which held the piston of 9 tons to the piston rod by means of eight bolts 3¼ ins. in diameter. Some of these bolts are still in the shoulder, with a small portion of the piston attached, suggesting that the piston was forced from the rod on account, perhaps, of some of the bolts becoming loose; the speed being high and the moving weight great would not admit of any play under the bolt-heads and nuts.

Since the falling of the propeller and 58 ft. of shaft into the dock, and the discovery that the outbearing next the propeller had worn considerably about 8 ins., the press assume that the wearing of this bearing 8 ins., allowing the shaft to drop this distance by degrees in the bearing, induced excessive strains at and near the stern tube, causing a complete fracture of the shaft at this point, as was discovered, followed immediately by the racing of the starboard engine. The engineering journals are disposed, with the owners of the steamship, to favor this conclusion. The conclusion seems reasonable to people who were not on the steamer at the time of the accident, but to those on the steamer not so reasonable. The facts do not indicate the wearing of outbearing and breaking of the propeller shaft as the primary cause of the accident, but one of the results of the primary cause.

I was in the engine room a few minutes before the accident occurred, and cannot favor the conclusion that the wearing of the bearing next the propeller was the primary cause of the accident. There were three well-known American engineers in the engine room with me and they are of the same opinion as myself. We examined the cranks and shaft of engine, and in detail examined the thrust plates, which take the thrust of the propeller—the shaft ran beautifully and the thrust plates were in perfect adjustment—and the bearings examined by us were not hot; in fact, the engine and all its parts seemed to be in perfect working order.

From the time of our examination to the time of the accident there were no unusual vibration to the steamer or any disturbance about the shaft or machinery that indicated anything wrong. Had the propeller been running with its shaft in a bearing worn down 8 ins., and the shaft at the stern tube in its proper position, which is true, the propeller and the shaft near it would have wobbled about 8 ins., and would immediately have notified the passengers and crew by the pounding disturbance and vibration of the steamer that something was wrong.

There was nothing of this kind. One of the engineers of our party after leaving the engine room passed to the stern of the steamer over the starboard propeller and shaft and saw nothing; neither did he feel any vibrations of the deck at this point indicating the propeller 8 ins. below its proper position. This gentlemen was at the stern when the accident occurred. The propeller shaft, no doubt, was broken outside the stern tube in the general breaking of the low-pressure cylinder; how, no one can tell. After this break occurred the bearing next the propeller had more load to resist than it should have had. While being towed by the steamer *Aldersgate* 200 miles to Queenstown, and then afterwards by the port engines considerably over 150 miles to Liverpool, the propeller rotated, which may have been sufficient to cause the wear of bearing referred to.

The accident occurred without the slightest warning and covered a period not to exceed 30 sec.

It does not seem reasonable to assume that the propeller could rotate 86 revolutions per minute 8 ins. lower in the bearing next the propeller than the other bearings at and beyond the stern tube nearer the engine without some indication that something was wrong. The outbearing next the port propeller and supporting the port shaft was in proper line and adjustment. The details at the point of connection of piston to rod and the question of piston speed should be investigated. Respectfully.

ROBERT GILLHAM.

Plaster Boards.

NEW YORK, April 23, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your number of April 12 you have an article entitled, "A New Floor Construction," in which you show one of the uses of a new material called plaster board. This article is evidently a translation from a German technical paper. The plaster boards referred to have been made in this country, both at Bergen Point, N. J., and at San Francisco, Cal., during the past six months, in yards which were put up for the purpose of demonstrating the practical use and cost of manufacture of plaster boards in this country. The Bergen Point yard has already filled a large order for plaster boards to be exported to Rio de Janeiro, and this yard is now filling numerous orders from various architects in New York City.

In your number of April 19 you have an article entitled, "A New Fire-Proof Floor," in which you give comparative estimates of the costs of different systems of floor construction, and it would seem proper at this time to compare with these other systems the cost of the ordinary floor construction using plaster boards as a fire-proof material.

In a floor where wooden joints are used, plaster boards of ⅝ in. or 1 in. in thickness are nailed on the bottom side of the joists forming the ceiling of the room which the floor covers, these plaster boards being afterward covered with a coat of hard finish applied directly to them. On strips nailed to the sides of the joists, plaster planks of 2, 3 or 4 ins. thickness are then laid, either forming an immediate floor between the ceiling and the regular floor, or being so laid as to be flush with the top of the joists, thereby giving additional strength to the floor proper. Vertical plaster planks are also inserted at intervals between the joists, breaking up the long flues of this form in floor construction into short dead air chambers in which fire cannot run.

The cost of such a floor of the same size as those given in your comparative estimate, would be as follows:

Say 9, 3x12 ins. joists 16 ft. long, 432 ft. B. M., at $15	$6.48
Strips	1.50
25 yds. 1 in. plaster board ceiling, 30	7.50
30 " 3 " " planks for blind floor and verticals, at 72	21.60
Single floor (as per former estimate)	11.35
White coat plaster, 25 yds., at 8	2.00
Side walls, same as for ordinary wooden floor	26.88
	$77.31

Single floor is estimated here assuming that the plaster planks are used as a blind floor and not as an intermediate one. In this estimate of cost, the cost of side walls is made the same as that given for the ordinary wooden floor.

Referring to the estimated cost of the "new fire-proof floor," I can see no reason why a less cost of side-walls should be taken for such a floor than for either of the two floors preceding it in the estimate. Moreover, with the great distance apart of the joists used in that floor, the necessity of a double flooring would seem to be greater than in the case of the ordinary wooden floor.

The estimated cost of the "new or Furness fire-proof floor," therefore, should be increased by the difference in cost of the side walls above referred to, and also by the additional cost for the double floor, making in all about $20, which, in all fairness, should be added to the estimated cost given, making the total cost of this floor, for comparison with the others, $110, instead of $90. There are various forms of construction of the plaster board floor, both with iron and wooden joists, which, of course, it would not be proper to try to show here.

The advantage of the plaster board, however, compared with the concrete floor referred to in your article, is, that the plaster board, while being equally fire-proof, weighs only about one-fourth as much as the concrete, and it is also put into the building *perfectly dry*. The plaster

boards can either be sawed or made of the right lengths to fit between the joists, and it will readily be seen that the labor of laying them would be much less than that of putting in the concrete. The temporary floor for supporting the concrete would not be used, and there would be no introduction of moisture whatever into the building.

The "plaster boards" are largely used in Germany where the writer first saw them last winter. They are meeting with favor here, and more orders have been received than the Bergen Point yard can at present comfortably fill. Arrangements are now perfecting by which the output there may be greatly increased.

Yours very truly.

THE AMERICAN PLASTER BOARD CO.
H. D. BUSH, Engineer.

[If our correspondent will examine somewhat more carefully the table of estimates for the Furness fire-proof floor we think he will acknowledge that the estimate for sidewalls is correct. The Furness floor is only 9 ins. deep, while the ordinary wooden floor is 15 ins. deep. Thus, with the same clear height between floors and ceilings, a saving is made in the total height of a building of 6 ins. per story. The double flooring in the ordinary wooden floor is needed to deaden sound and secure warmth. The 4-in. layer of concrete would seem to do this effectually in the other floor. We make this comment without prejudice for or against either type of construction, both of which seem to have marked advantages over the common wooden floor.—ED. ENG-NEWS.

A Mathematical Anomaly Explained.

CORNELL UNIVERSITY, ITHACA, N. Y., May 7, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of May 3 you call the attention of your numerous readers to "a certain mathematical anomaly involved in the Weather Summary for March, published by the State Meteorological Bureau. Since you say you are puzzled to understand how 85.5 per cent. of the combined verifications for weather and temperature predictions could be obtained from 84.3 per cent. of the verifications for weather and 87.3 per cent. of the verification for temperature, will you be so kind as to give this explanation the same prominence in your columns that you gave to your criticism of the summary?

The "mean" you criticise is expressly called a combined mean. The arithmetical mean obtained from quantities or elements of absolutely the same kind is an exact mean; but when these elements, though of the same general nature, cease to be identical on account of differences which follow some law more or less accurately known, the individual elements (like witnesses of different degrees of credibility) are always given a power to influence the ultimate result in proportion to the intrinsic value ascribed to them. Averages or means thus obtained are called "weighted means," and are necessarily employed in astronomical and physical researches; and, in fact, in nearly every kind of experimental investigation dealing with approximate results, which must be combined in order to obtain the most correct value possible. Thus, one observation with a transit may be considered eight times better than ten careful observations with a sextant. Temperatures taken at 7 A. M. and 2 and 9 P. M. will give the mean temperature for the entire day very nearly, by giving double weight to the last observation; or by adding to the sum of the other two observations, twice the value of the last, and dividing the total sum by 4.] Other nearly definite relations exist for temperatures taken at other times or when using only the maximum and minimum temperatures of the day. In these, and in innumerable other cases, the "weights" are determined by the plotting of curves, discussions of observations, differential equations, the laws of least squares, or other logical considerations.

This bureau is not responsible for the predictions, which are made by the National Service. It only receives the reports from over 150 observers in the State, and, under instructions from Washington, multiplies by 6 the percentage of weather verifications; by 4 the percentage of the temperature verifications, dividing the sum by 10: thus in the case you mention $(84.3 \times 6 + 87.3 \times 4) \times \frac{1}{10} =$ 85.50 is assumed as the weighted mean. This is called also a combined mean, and so designated in the summary you criticise. I am unable to say why these particular weights have been chosen by the Chief Signal Officer of the United States; but I have no doubt that their selection has been the result of some carefully considered discussion of statistical or other data. The rule adopted is not incompatible with the doctrine of weights as applied to the quantities of which the final combined result is made up.

E. A. FUERTES.
Director N. Y. Meteorological Bureau.

The Statistics of American Railway Bridges.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: It would be useless to attempt to enlighten your correspondent Mr. STOWELL upon the subject of American railroad bridges. It is also a waste of time to answer insinuations. He apparently has never read my paper, or has been so blinded by prejudice that he could not understand plain English. For the benefit of your readers, I would state that the data for the two roads in New York which he mentions were obtained from officials of the company, and do not differ sufficiently from those given by Mr. STOWELL, although 326 miles of the Erie system are "out of New York," to be noted.

I distinctly state that I have not taken all the roads in any one State, but have selected "such data as appeared correct and complete" It seems to be a very great stretch of imagination for Mr. STOWELL to interpret "other roads in New York" to mean "all other roads in New York," after the above statement that I have selected my data, not to prove any point, but because of apparent errors in the reports of other roads.

I devoted much time and correspondence to seeking the truth as far as possible. That there may be errors in my statistics I do not question, and would be glad to have them made, if possible, absolutely correct. But that there are any great errors in the examination I do not believe.

As you, Mr. Editor, have questioned the relative proportion of iron to wooden bridges, I would again state that this relation was established with great care in the same manner as the other results, by using the detailed information furnished me by roads covering over 26,000 miles of track, and testing the results by such data from the various railroad commissioners' reports as I could obtain.

I, moreover, checked the amount of iron bridges in existence by a comparison with the actual output of several of the oldest and largest bridge companies in the country and the estimated output of the smaller ones.

Much of the data at my disposal was "not for publication," but I was at liberty to use it for general conclusions.

Yours very truly,

THEODORE COOPER.

Bridge Strains Produced by Loaded Cars of 90,000 lbs. Capacity.

PATERSON, N. J., April 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of March 22, 1890, your editorial correspondent, unduly impressed with the enormous size and great weight of a boiler and a bed casting for an engine asks: "How many of the men who are paring down the weight of bridge members, or figuring out wheel loads to the hundred-weight would be anxious to have one of these heavy castings or big boilers billed over the line of railway under his charge?"

With the highest regard for the usual soundness of your judgment in professional matters, allow the writer to differ with you in this case. No bridge engineer, who has taken the wise precaution of adopting a loading, fairly typical of actual usage, in the design of his bridges, would have the least hesitation in consenting to the transportation of such loads over any of the bridges proportioned by him or constructed under his specification.

A comparison of the strains in bridges produced by such heavy loads, with those provided for by the typical concentrated loads of bridge specifications, may be interesting to many of your readers. Two conditions of possible actual loading are considered: the first, shown in Fig. 1, is a train, headed by a Wootten consolidation locomotive—the heaviest used in the freight service of the N. Y., L. E. & W. R. R., engine and tender in working order weighing 98 tons, followed by two special platform cars, weighing 30,000 lbs. each, such as are used by the locomotive works in this city for the shipment of locomotives, one of these cars carrying the 90,000-lb. boiler and the other the 90,000-lb. engine-bed casting, the remainder of train being 60,000-lb. capacity "Erie Elevator" grain cars,

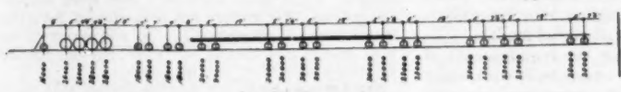


Fig. 1.—Wheel Load Diagram: Two 90,000-lb. Capacity Cars Placed Next to Consolidation Locomotives.

Fig. 2.—Two 90,000-lb. Capacity Cars Placed in Center of Train.

weighing, when loaded, 92,000 lbs. each. The second loading is shown in Fig. 2, where the two cars carrying the boiler and casting are placed somewhere in the middle of such a train of "Erie Elevator" cars.

Two typical systems of concentrated loading are also considered, the one, from the "General Specifications for Iron Bridges," N. Y., L. E. & W. R. R., 1887, chosen for its being, so far as known to the writer, the lightest loading specified by any of the eastern trunk lines; the other, from THEODORE COOPER'S "General Specifications for Iron and Steel Railroad Bridges, etc.," 1888, and classed there as "Extra Heavy A." The latter loading, or its close equivalent, is in use by many of the railroads and represents good present practice.

The strains produced by these four methods of loading, upon spans of 50, 100, 150 and 200 ft., respectively, are given in the table, which was calculated by the graphical method. The "Erie" loading produces, on the average, 2 per cent. less strain than Load No. 1, and 6 per cent. more than Load No. 2. COOPER'S "Extra Heavy A" provides for strains, on the average, 13 per cent. in excess of load No. 1, and 22 per cent. in excess of load No. 2.

It is but fair to state here that the small deficiency in the "Erie" loading is more than covered by the liberal methods employed, by the same specification, in proportioning the members, which would be needless to mention in detail.

A few words regarding the relative merits of concentrated *vs.* continuous loading may not be out of place. How well concentrated loading provides for actual cases, the accompanying table serves as an excellent illustration. No doubt, after many trials, one may be able to hit upon a uniform load, which will produce results in the close neighborhood of the concentrated system. The advocates of a continuous load admit the superiority of the concentrated system; they have bespoken for their system

COMPARATIVE TABLE OF LIVE LOAD STRAINS.

MAXIMUM STRAINS.		Load No. 1.	Load No. 2.	Erie.	Cooper's A. ex. heavy.	Per cent. diff. Erie compared with No. 1.	Per cent. diff. Erie compared with No. 2.	Per cent. diff. Cooper's A. ex. hy. compared with No. 1.	Per cent. diff. Cooper's A. ex. hy. compared with No. 2.
50 ft. span 4 panels of 12.5 ft.	Bending moment, stringers..	65	60	63	73	− 3	+ 5	+ 12	+ 22
	Stringer reaction.....	26	24	25	29	− 4	+ 4	+ 12	+ 21
	Floorbeam reaction.....	34	30	33	37	− 3	+ 10	+ 9	+ 23
	Bending mom't, main girders	645	575	613	755	− 5	+ 7	+ 17	+ 31
	End reaction, main girders..	58	56	57	65	− 2	+ 2	+ 12	+ 16
100 ft. span 5 panels of 20 ft.	Bending moment, stringers..	147	131	147	159	0	+ 12	+ 8	+ 21
	Stringer reaction.....	35	34	35	39	0	+ 3	+ 11	+ 15
	Floorbeam reaction.....	44	41	43	52	− 2	+ 5	+ 18	+ 27
	Bending moment, trusses....	2,060	2,000	2,030	2,483	− 2	+ 2	+ 18	+ 23
	Shear, end panels of trusses.	72	67	69	84	− 4	+ 3	+ 17	+ 25
150 ft. span 7 panels of 21.43 ft.	Bending moment, stringers..	166	147	165	180	− 1	+ 12	+ 8	+ 22
	Stringer reaction.....	36	35	36	40	0	+ 3	+ 11	+ 14
	Floorbeam reaction.....	46	42	45	54	− 2	+ 7	+ 17	+ 29
	Bending moment, trusses....	4,590	4,310	4,490	5,525	− 2	+ 4	+ 16	+ 24
	Shear, end panels of trusses.	112	102	108	128	− 4	+ 6	+ 14	+ 26
200 ft. span 8 panels of 25 ft.	Bending moment, stringers..	214	196	212	234	− 1	+ 8	+ 9	+ 19
	Stringer reaction.....	40	39	39	44	− 2	+ 9	+ 10	+ 13
	Floorbeam reaction.....	51	46	49	60	− 4	+ 7	+ 18	+ 30
	Bending moment, trusses....	7,910	7,490	7,840	9,075	− 1	+ 5	+ 15	+ 21
	Shear, end panels of trusses.	145	132	142	166	− 2	+ 8	+ 14	+ 26
	Average.....	.....	.....	.....	.....	− 2	+ 6	+ 13	+ 22

Bending moments are given in 1,000 ft. lbs. for ⅛ track.
Shears are given in 1,000 lbs. for ⅛ track.

the highest commendation when they claim close identity of results with the concentrated loading. Like the venders of an imitation, their best recommendation is, that it produces results just as good as, or about the same as, the wheel loads, and in less time. "The enormous waste of high priced labor" is deplored by the apostles of continuous loading, and if only their system were adopted how much needless labor might be saved! By the way, who is it that generally complains? Is it the overworked engineer of the bridge company, a part of whose daily duty it is to calculate such strains, or is it the one who occasionally has such a calculation to perform?

Will some advocate of the uniform load system kindly say how long it takes him to arrive at the loading he uses in any special case, and how much such an operation is a matter of judgment and how much a matter of calculation? The engineer constantly engaged in designing bridges, not unfrequently under specifications new to him, and at short notice, has become expert, and moreover extremely rapid in such calculations. He does not figure to single lbs., only novices do that, but he is content to be within a thousand lbs. Such machines as that described by Prof. FLETCHER in ENGINEERING NEWS, March 1, 1890, will scarcely find a place in the computing room of a bridge company. The writer prefers, for instance, where such a device could be used, the slide rule and a knowledge of the properties of the parabola.

The wide difference between the allowed working strains and the limit of elasticity is too weak an excuse for inaccurate strain sheets. When bridge members are strained to, say, 15,000 lbs. per sq. in., why is it that the bridge begins to show signs of weakness? And why is it that steps are soon taken for its renewal? The Railroad Commission of the State of New York would demand the removal of such a structure, and yet some would have us to believe that there was still a wide margin!

G. H. BLAKELY.

[Our correspondent's comparison of the strains produced by two loaded cars of 90,000 lbs. capacity will be examined with interest, we are sure, by all bridge engineers. Cars of 80,000, 90,000 and 100,000 lbs. capacity are becoming increasingly common, not only for carrying special machinery, but, as in the case of the car illustrated on our inset sheet, April 19, for carrying iron ore and such heavy bulk freights. The purpose of the writer of the article above criticised was rather to question the practice of engineers who, because of the present poverty of their company and the pressing demand for economy, are dimensioning bridges for much lighter loading than any mentioned by our correspondent. However, the facts shown by the diagrams Mr. BLAKELY has taked the pains to prepare, that two loaded 90,000-lb. capacity cars produce a concentrated load of 120,000 lbs. on a wheel base of 17 ft. 6 ins. is one which seems to demand the attention of even the most progressive bridge engineers.

This is a greater concentrated load than is produced by any locomotive except the heavier consolidations and the few engines heavier than consolidations that have been built. Mr. BLAKELY shows that COOPER'S "Extra Heavy A" specification provides for a loading considerably in excess of that produced by the above cars, however placed. This specification, he says, represents good present practice. But reference to COOPER'S specifications shows that of the five loadings there given "Extra heavy A" is next to the heaviest. The three lighter loads designated as A, B and C are considerably less than the loads produced by the 90,000-lb. cars; and if we mistake not, there are not a few railways where it would be thought an extravagance to design bridges for heavy consolidation engines which are never run over the road.

The question which every bridge engineer should ask of himself as he dimensions an iron bridge, is: "How long do I expect this structure to stand?" Certainly, it should not be expected to need replacing under 25 years, and why should it not be built to stand for a century? The wheel loads for which a bridge should be proportioned, then, are not those of to day only, but those which may come upon the structure twenty, fifty or even a hundred years hence. Who knows what these will be, or how distributed? This much only is known, that they are pretty certain to be considerably heavier than those now in use. The heavy boiler and bed-plate which started this discussion well illustrate the inevitable tendency. The manufacture of heavy machinery in this country is as yet a small industry compared with the work which England and Germany are doing. Can it be doubted that the manufacture of heavy tools and machines is destined to as great development here as abroad, and probably to far exceed what has been done there?

Undoubtedly, too, we have not yet reached the limits of economy in the increase of locomotive weights and wheel loads. If any engineer is so endowed with the spirit of prophecy as to be able to foretell with certainty what loads will pass over the bridges on a given railway in the year 1940, he is perfectly right to dimension his bridges in accordance therewith. It may be quite true that a better distribution of strains is effected, if actual engine wheel loads are taken in connection with a distributed load, and both are made ample. But whether this is done, or an ample distributed load alone, headed by some equivalent concentrated load, is assumed to be of comparatively little importance. The great fact that every bridge engineer should fully appreciate is that it is safer and, in the end, cheaper, to build one bridge to last a hundred years than to build three bridges to last 30 years; that the future wheel base may be quite different from the present wheel base, and that the actual strains are very different from the merely static strains figured on the strain sheet.

"To pare down sections and figure strains to the hundred weight" for the Mogul locomotives, which happen to be the heaviest engines now running on a road, is to be penny wise and pound foolish.

A bridge just sufficient for the requirements of to-day, costs nearly as much as one built with heavy sections and able to stand the wear and tear and corrosion of a century. The difference in cost is not proportionate to the difference in strength. As to this, we shall shortly give some striking evidences. Millions of dollars have been spent in the last decade in repairing iron bridges once quite sufficient for the traffic; but these had been built in the early days of the railway, when the future weights of rolling stock could not be prophesied. There is to-day no excuse for such a policy on the ground of ignorance, and the name of an engineer of the present day whose bridges will have to be rebuilt to carry the rolling stock and loads of 1940 will be little respected by those who follow him.—[ED. ENG. NEWS.]

Experience with Highway Bridge Designs.

MONTCLAIR, N. J., April 23, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of April 19 I notice a detailed list of bridge accidents, mostly railroad bridges, and, as if it were a natural sequence to it, there is an abstract of a proposed law for the prevention of the erection of poor or imperfect highway bridges in the State of Missouri.

The salient point in the list of accidents to bridges was, that in one bridge failure it was a *square fall*, and the fact is noted as being exceptional.

In the abstract of the proposed law in Missouri, the erection of any bridge is to be referred to the wisdom and judgment of an "expert." Without making any formal protest to the use of the word "expert" in an engineering sense, the question occurred to me as to what would be the definition of the word expert under the laws of Missouri, and then what would it be in a strictly professional view.

In an experience of twenty years in erecting highway bridges in the county of which I am engineer, and of taking care of them after they have been erected, the bridges were of all kinds and sizes, and involved an outlay during that period of $1,000,000 to $1,500,000; and in the expenditure of this money, I have taken care that none of the larger spans were designed by others than acknowledged experts. I have found that an engineer who designs a bridge looks at its construction somewhat differently and in a more technical manner than the engineer who has to watch its daily behavior under different and varying conditions; and I have further found that the acknowledged standard in use ten or fifteen years ago has been greatly modified at the present time, and what would be considered good then is deemed bad now.

I make this statement to show that especially in the cases of highway bridges, we are still groping, and that an "expert" in bridges is under any circumstances a misnomer. The strains on highway bridges twenty or thirty years ago were calculated carefully on the basis of the load acting vertically, which should be carried quickly and easily to the abutments. Many books and pamphlets have been written and endless discussions have been had on this portion of the duty of the bridge. Beyond it it was felt that there was something more to be taken care of, so the factor of *safety* was introduced to cover the rest. In plain words, 20 per cent. was very carefully calculated and the balance of 80 per cent. was guessed at. How this standard of a factor of safety of 5 was adopted I know not, but it was not far from the truth, as an occasional collapse of a bridge built on that standard will show.

In the subsequent investigations of long span bridges, especially of railroads, this factor of safety is being slowly eliminated. The inherent elasticity of the iron, the action of the wind, the irregular strains of moving loads are now acknowledged as elements to be carefully considered, their action truthfully arrived at, and the metal judiciously placed in known quantities; but in highway bridges, with spans of 60 to 100 ft., the effects of moving loads, light or heavy, the patter of the horses's feet, the rythmic joggle of a light cart over planking of uniform width with the corners worn and the centers crowning, are all elements affecting its action, and, to my mind demand careful consideration.

I do not deem it good construction that the floor and overhead bracing of round rods should oscillate vertically at the instigation of a light pony carriage; nor do I think that the main diagonal rods of a deep truss should wobble for the same cause; nor should it be necessary to bind with wire these same diagonal rods to keep them from flapping against the vertical posts; nor do I think it proper that a one-horse cart, with two wheels, loaded with earth should cause a low truss bridge to grunt and wave laterally, as if it had all it could carry. These instances I have observed time and again, and it has been my object in the past few years not to take the plans of bridge experts *per se*, but to definitely state the class and kind of bridge wanted. The results arrived at are as follows:

No trusses under 50 ft. Use either rolled beams or plate girders. When these are used, I turn brick arches between them. The girders are proportioned for a load of 300 lbs. per sq. ft., to include live load and pavement—there is no lateral or oscillating movement, but only the slightest tremor with heavy moving loads.

From 50 ft. to 100 ft. low, riveted trusses, with no bars or rods, but all angle irons in the structure. In this form all vibrations are eliminated, and the only objectionable movement is the oscillation of the top chord of the trusses, which I find is very hard to get rid of. In spans from 100 ft. to 200 ft. the iron increases in section so fast that the inertia begins to be sufficient to overcome the vibration due to the load, and consequently pin-connected bridges can here be used and our troubles are greatly reduced; but I still would suggest the substitution of compression members in the top and bottom laterals instead of the rods usually used. I would here state that these movements of the different members were all under light moving loads, on bridges amply strong under all accepted authorities; and in no way was there even a suggestion of lack of safety; for the same bridge that jumped "lively" at the passage of a light cart carried a 20 ton steam roller with no undue strain.

My object in these remarks is to show that the expert acceptance of a standard of highway bridges is not up to the excellence that we all hope to attain, and that while millions of dollars are being spent every year in this very industry, it is incumbent upon the profession to insist on a more industrious investigation of these small but effective movements and corresponding attempts to overcome them by proper construction. JAS. OWEN.

[Our readers, we are sure, will agree with us that these observations as to highway bridges are much to the point, and that the same indeterminate vibrations and strains modify greatly the question of the proper design of railway trusses.—ED. ENG. NEWS.]

Mechanical Determination of Truss Stresses III.

THAYER SCHOOL OF CIVIL ENGINEERING AT DARTMOUTH COLLEGE, HANOVER, N. H., April 30, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of the 12th inst. appeared a lengthy criticism of an article published six weeks earlier, where in I described a device for mechanical determination of stresses in trusses with paralled chords.

Between the critic's professed desire "to avoid too much criticism" and his efforts to fathom ambiguities we are treated to a great array of "inaccuracies." As very few of your readers would have any interest in a detailed explanation, and as the present writer has no disposition to engage in controversy, a little of your valuable space is desired, simply to reply to the more serious "charges," and present a few statements pertinent to the subject in question.

The device was described with some diffidence as possibly novel, and having a degree of utility under certain circumstances explicitly stated. There are some who think more favorably of it than our critic, but if it has served no other end than, by the description, to draw into the light of publicity the very neat and simple method of Prof. WEBB, it has led to a good result.

No question was raised as to the superior accuracy of results deduced by an assumption of wheel-load concentrations, and any intention to argue the matter at that time was disclaimed. The operation of the device is based upon a certain approximate method, and if that method is inapplicable the device is useless. The writer has made use of all the accepted methods of computation, both arithmetical and graphical, for uniform loading and for wheel concentrations, and tested the merits of the sliding

"moment scale" described in ENGINEERING NEWS of April 14, 1888.

We are all agreed as to the distinction between accuracy and precision. It is fundamental. With the writings and monumental works of SMEATON, PERRONET, TELFORD, RANKINE, ERICSSON and other masters of the profession before us, it is strange if the fact "that the best engineers make the most complete and accurate calculations of their work" is a "truth" only *now* "fast gaining recognition."

The point was distinctly made that the use of the approximate method secures brevity. With the highest possible regard for accuracy—with the *proper degree* of accuracy in a given case—we deprecate over-confidence in a "precision" which may be delusive. The "typical engines" are often different from many actually in use on a given road, and so rapid and great are the changes in weight and design of locomotives that specifications on such a basis may soon become obsolete. In the *Railroad Gazette* of Sept. 17, 1887, page 643, the editor, commenting on Mr. Jos. M. WILSON'S "Specifications for Strength of Iron Bridges," shows that within six months after the presentation of that paper and discussion in the American Society of Civil Engineers, a locomotive was built which would cause greater stresses than Mr. WILSON'S "standards," which were to be a maximum for the future. The question is not one of proper precision in computation—for which no engineer would feel contempt—but one of over precision in the assumption of loading.

A high authority, Mr. GEORGE H. PEGRAM (Trans. Am. Soc. Civ. Engrs., Vol. 15, p. 475), says: "The direct use of the engine loading, in any case, involves a deal of work, is often inexact, and it seems to me rather unscientific." Also, in discussing Mr. COOPER'S recent paper on "American R. R. Bridges," he says (Trans. Am. Soc. Civ. Engrs., Vol. 21, p. 575): "In my discussion of a paper by Mr. Jos. M. WILSON. . . . I showed that a uniform load in combination with a single concentrated load would give all of the results obtained by the use of the engine loading with substantial exactness.

"Examples were given of spans from 8 to 400 ft. girders; and single and double intersection trusses with a variety of panel lengths sufficient, it was thought, to place the question of the entire equivalence of the two loadings beyond dispute.

"The severity of the test was increased by the requirement of Mr. WILSON'S specifications that the maximum strains from three different classes of engines should be taken. This requirement was made by Mr. WILSON to cover the greater concentration of weight on the wheels of some tank and passenger engines. If he had gone a step further, and required different positions of these engines with reference to each other and to the train he would have represented still more accurately the loading to which his bridges were subjected. Such a condition would, however, be proscribed on account of the complexity of the specifications and the large amount of labor required.

"It is therefore claimed that the proposed loading, though practically representing an average of all the combinations of loading, gives more accurate results than the engine-loading specified, and since through its use *the strains can be determined in about one-quarter of the time* (words italicized by us) ordinarily taken when only *one* class of engine is specified, its general use would seem desirable. In still other respects it is better in insuring the same results by all calculators, being independent of prepared tables and diagrams, and allowing a choice of finding the strains by either the analytical or graphical method with equal convenience."

A summary of "principles" (the writer stands corrected in the use of the word "elementary" in such connection) was given to render the description which followed more intelligible. It was incomplete because there was no attempt to give full instructions to readers not familiar with the subject. It goes without saying that in application to trusses as distinguished from solid girders the uniform load is assumed to be concentrated at panel points and to extend over half a panel at head of train, when the statement is made that shear ordinates are to be measured at mid-panel.

It was also taken for granted that the well-informed reader would understand that the *true* shear would be found only by extending the head of load to a point in the panel, which depends upon the position of the panel and the number of panels in the truss, since the demonstration was published in 1873 by Prof. WOOD, and perhaps much earlier. To avoid stating a principle not to be used, the writer for brevity used the indefinite term "some point." Again, since the same parabola was to be used for any span and any number of panels, it is true that the *exact* shear is not given at mid-panel points by the curve, but one *slightly in excess* of the true value, an error on the safe side. This fact should have been pointed out.

Now as to the results, "from 1 to 25 per cent." too great, which the critic finds in the example. He ought to have been content to take the figures as a sufficient indication as to how the bridge is loaded at the ends. His "case A," which shows a discrepancy of more than 6,000 lbs. on end brace and the largest variations on other members, is a gratuitous assumption, entirely irrelevant in this instance. Moreover, as this truss is peculiar in having a half panel at each end, it was presumed that the intelligent reader would know that the first shear would be given by the *end* ordinate instead of that at first mid-panel point.

In his table of results, lines 2, 3, 4, 10 and 12, Prof. WEBB gives a series of values which agree so closely with those of the writer—all computed by a method in common use—that there is no case for criticism. For the uniform load without excess the discrepancies are all less than 2 per cent. except on the *counter*, where the divergence from figured result is nearly 4 per cent. Probably a little imperfection in the graduation of the panel strips may account for part of this, the rest being due to the use of a parabola which is not quite in true place, as noted above.

Our critic then deduces a series of "correct" values, which differ so widely from the others that he is moved to remark: "The method employed is crude and incorrect, both for the uniform load and for the same load with excess load added." His precise results are obtained by extending the head of train into each panel to a point given by the expression $\left(\frac{n}{m-1}\right)p$,—in which n is the ordinal number of the given panel, p the panel length, and m the whole number of panels,—and figuring from the position of the center of gravity of the entire load. As stated above, this method was intentionally ignored. Certainly *absolute precision* must require its use, and on that point, Prof. WEBB and the writer may shake hands heartily. But the method is not in common use, unless the writer is grievously mistaken. In Prof. MERRIMAN'S recent work on "Roofs and Bridges," part 1, p. 91, a table is given for an eight panel truss comparing the values of shears obtained by the *usual* method and by the strict method, showing for the counters discrepancies of from 8 to 30 per cent. On this he remarks: "It is seen that the difference is least at the ends of the truss and greatest near the middle. Inasmuch as the differences are all small and the usual method errs on the safe side, the latter is generally employed, and will hereafter in this chapter be used unless otherwise specified." Recent inquiry among engineers now designing some of the heaviest railroad bridges yet erected in this country (as to the weight borne per foot) elicits statements that they are using a basis of uniform rolling load with excess at one panel point; that they use *panel point concentrations*, and that this is the method in general use. This from men who have been connected for years past with the designing of some of the best recently built bridges, East and West. The recent specifications for one of the large railway systems of the country prescribe a uniform rolling load varying per foot according to length of span.

As to the *crudity* of the method which depends upon the equilibrium polygon and shear parabola, the reader may find in Howe's "Sabula Drawbridge" (published by *The American Engineer*, Chicago, 1886), a comparison of results obtained graphically and by the arithmetical method of moments. These agree within 2 per cent., and generally much closer. Mr. C. Shaler Smith prescribed in the calculation of this bridge a uniform moving load with one panel point concentration of excess load.

To anticipate any future imputation of ambiguity, we will suppose it to be well understood that engine-loads constitute the basis of assumptions of uniform load, with any additional allowance which may be deemed expedient. Of course, this involves preliminary computations, but these once made to fix standards for different weights of traffic, all subsequent labor is much abridged, as before noticed.

Of course, in figuring an existing bridge, suspected of being too light, it would be unfair to judge the web members by results which err by excess. If we could be absolutely precise in our assumption of load we *must* use the method which is mathematically precise. But the *counters*,—where errors in excess are greatest—usually have surplus metal anyway. In a case in the writer's experience the counters have abundant section, while for the members at and near the ends, where the errors of the above method would be least of all, the sections prove to be inadequate.

In conclusion we may repeat that Prof. Webb and the writer are fully agreed as to the importance of a high degree of accuracy in the calculations of an engineer; and we may add that even very common usage cannot justify inaccurate methods. But when experts in bridge designing adopt a method which they think to be adequate for the conditions under which they work, we must let them be the judges as to the degree of precision which it is desirable to attain. Necessarily these remarks relate chiefly to modern iron panel bridges. Howe truss bridges, especially as to the members in wood, have not generally been built by very close calculation, although the majority of the older ones now need very close *re-calculation* for present increased weight of traffic.

Lest the writer may appear to ignore the equally eminent authority on the other side, it may be proper to add that he has the highest respect for the opinions of those who prefer to use wheel concentrations; but, until the experts agree, and establish a basis which shall be generally accepted, the writer prefers to sit on the fence *fronting squarely* toward the side of uniform loads. As an instructor, he presents both methods necessarily.

ROBERT FLETCHER, Assoc. Am. Soc. C. E.,
Prof. of Civil Engineering.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Columbus & Maysville.—The rights and franchises of this company have been sold under an order of foreclosure, to secure the payment of $200,000 of bonds to the Central Trust Co., of New York City. The property was sold to E. F. Hyde, John Barker, and Wm. Parkin, trustees for the bondholders, for $50,000. The road was projected to run from Washington C. H., Ohio, to Aberdeen, O., 85 miles. The division from Hillsboro to Ripley, O., 4 miles, is in operation, and a considerable portion of the remainder has been graded.

Ohio Valley.—The contracts for building the extension from Bellaire to Powhatan, O., have been awarded as follows: J. C. Gibney & Co., of Indianapolis, Ind., 6 miles; Serfee & Morris, of Louisville, Ky., 5 miles; T. J. Hart, of Marietta, O., 1 mile, and Miller & Stoehr, of Steubenville, 1 mile. The cost of the entire 13 miles, exclusive of bridging, will be $143,000. Work is to begin at once.

Shepaug, Litchfield & Northern.—It is stated that this company will assume control of the Portchester, Ridgefield & Danbury R. R., and will build a short branch connecting the two lines at Hawleyville, Conn.

Baltimore & Eastern Shore.—Work is being pushed on this Maryland railway. It is now expected that the entire line will be completed by July 1.

Philadelphia & Reading.—A press dispatch from Philadelphia, Pa., says:

The Philadelphia & Reading Ry. Co., which has been getting scarcely any freight from Brooklyn, has obtained control of a plot of ground at the foot of Grand st., in Brooklyn, which it will convert into a freight yard capable of accommodating 75 cars and equipped with strong derricks. Freight will be moved to and from Jersey City by means of large floats. General Freight Agent Bell believes that the new station and yard will give the Reading advantages in Europe superior to those of its competitors.

Lehigh Valley.—The increase of the capital stock of the Geneva & Van Ettenville Ry. Co from $600,000 to $1,000,000 has been approved by the State Railroad Commission. The new stock is to be disposed of at not less than par, and in exchange for the stock of the Geneva & Sayre and the Auburn & Ithaca R. R. The cost of building the new road, 56¼ miles in length, and the double tracking of the Geneva & Sayre R. R., it is estimated, will be about $2,800,000.

Columbus, Lima & Milwaukee.—At a meeting of the stockholders of the Columbus, Lima & Milwaukee R. R., recently held, the following board of directors was elected: B. C. Faurot, F. L. Langan, D. J. Cable, E. P. Graf, E. P. Hooker, L. C. Newsor and H. Sabine, of Columbus, O.; L. E. Strong, of New Hampshire, and M. J. Markle, of Detroit. The board organized by electing B. C. Faurot, President; L. C. Newsor, Vice-President; F. P. Graf, Secretary, and D. J. Cable, General Counsel. Lieutenant-Governor W. V. Marquis was elected to the board in place of M. J. Markle.

Maine Central.—It is stated that this company has leased the Upper Coos R. R., and will build a link connecting the two roads between Lunenburg and North Stratford.

Wabash.—The contract for the construction of the Peru & Detroit Ry. has been let to Zachariah Shrop, of St. Louis, Mo. The Detroit Bridge Co. has the contract for the 260 ft. bridge over the Eel River at Chili.

Cleveland, Cincinnati, Chicago & St. Louis.—The statement of this company for the first 9 months of its fiscal year shows the following results from operations as compared with the previous year:

	1888–89.	1889–90.
Gross earnings	$8,805,611	$9,444,468
Operating expenses and taxes	6,107,399	6,397,856
Net earnings	$2,698,212	$3,046,612

New York, Lake Erie & Western.—This company is making extensive improvements along the Weehawken river front. The company will build large freight piers at a cost of $1,500,000. The oil wharf will be torn down and large inclosed freight wharves will be constructed north of the present site of the oil dock. The proposed improvements will provide a freight yard large enough for the storage of 220 freight cars. Work has been begun on the improvements, and they will be finished by next fall.

Toledo, Ann Arbor & North Michigan.—The Manistee & Luther lumber railway is to be changed to standard gauge and will form a part of the Chippewa Valley R. R., projected to run from Mt. Pleasant to Manistee, Mich.

Lake Shore & Michigan Southern.—The annual report of this company for the year ending Dec 31, 1889, shows the following results from operations as compared with the previous year:

	1889.	1888.
Gross earnings	$19,487,190	$18,029,627
Operating expenses	12,847,451	11,310,371
Net earnings	$6,639,745	$6,719,256

Projects and Surveys.

Baltimore, South Baltimore & Curtis Bay.—It is stated that contracts will soon be let for the construction of this short Maryland railway. W. S. Rayner, of Baltimore, Md., is interested.

Plymouth & Middleboro.—The town of Plymouth, Mass., has voted $40,000 of bonds in aid of this road. The road is projected to run from Plymouth to Middleboro, Mass., a distance of 16 miles.

SOUTHERN.—Existing Roads.

Way Cross Air Line.—About 27 miles of the division from Way Cross to Douglass, Ga., have been completed and grading is in progress on the remaining 14 miles. The road is to be continued from Douglass to Cordele, where connection will be made with the Atlantic & Florida R. R. The headquarters of the company are at Way Cross.

Rutledge & Julian.—Work, it is stated, is progressing rapidly on this Alabama railway, and it is expected to have the line completed in a short time. The road runs from Rutledge to Julian, Ala., 3 miles.

Gulf & Chicago.—Col. C. C. Merrick, the President of this company, states that construction will be commenced as soon as the right of way can be secured. The contract was let a short time ago.

Empire & Dublin.—Three preliminary lines have been surveyed for the extension from Hawkinsville, Ga., to Grovania, where connection is made with the Georgia Southern & Florida R. R. Locating surveys will be commenced soon, and the line put under construction and completed this season.

Alabama Midland.—Grading on the Montgomery, Tuscaloosa & Memphis R. R. has been completed to a point 8 miles northwest of Prattville, Ga. The contractors on this division are making preparations to commence work beyond Maplesville, Ala., as soon as the surveys are completed.

Chesapeake & Ohio.—President Ingalls, of this road, is quoted as speaking as follows concerning the improvements of the road now in progress and projected:

"The business of the road is growing steadily, and the owners are well pleased with the outlook. We have under contract 25 miles of double track in the mountains. We will have our plans for building a freight belt line around Richmond ready to submit to the city council during the summer. When our route is agreed upon we will get everything ready to go to work on the construction, which will not be later than next spring. We expect to bring our passenger trains in over the Richmond and Alleghany tracks and build a fine depot in that part of the city, discontinuing the use of the old Chesapeake & Ohio depot. This work of belt line construction that we are planning to do in and around Richmond will cost something like $1,000,000."

Norfolk & Western.—This company will receive proposals until May 15 for the construction of a stone passenger station at Graham, Va., and of a combination brick and stone passenger station at Bristol Tenn. Plans and specifications can be seen at the office of Charles S. Churchill, Engineer Maintenance of Way, Roanoke, Va. to whom all communications should be addressed.

South Bound.—Surveys have been commenced on this road from Savannah, Ga., north. George Dale Wadley is Chief Engineer.

Projects and Surveys.

Union City, Louisville & Memphis.—W. H. Gardner of Union City, Tenn., President, writes us that work will commence on this road in July. The object of the road is to give Union City a connection with the Newport News & Mississippi Valley R. R.

Tennessee & Alabama.—J. L. Girten, of Winchester Tenn., General Manager, writes us that this company has recently sold 110,000 acres of land lying in Franklin Co., Tenn., and Jackson Co., Ala., to a syndicate of English capitalists. This syndicate proposes to build furnaces and rolling mills, and to develop its coal and timber interests. The syndicate will also buy the charter of the R. R. Co., and will construct the road, which is projected to run from Winchester, Tenn., to Bellefonte, Ala., 62 miles. It will be built principally for the mineral and timber traffic, but will also do a general freight and passenger business.

Talbotton & Western.—W. H. Martin, of Talbotton, Ga., writes us as follows concerning this enterprise:

The road is projected to run from Waverly Hill, on the Georgia, Midland & Gulf R. R., or Ellerslie, Ga., via Talbotton, Prattsburg and Carsonville, to Flint, Ga., a distance of 30 miles. The surveys are now in progress and will be completed about May 15. The route is through a good agricultural region affording easy work; maximum grade 66 ft. per mile and maximum curve 6°. All the right of way has been donated and sufficient other local aid given to grade the roadbed. Among those interested in the enterprise are: W. A. Little, Columbus, Ga.; J. H. Martin, Talbotton, Ga., and J. T. Parker, of Prattsburg, Ga.

Paducah & Hickman.—A correspondent writes us as follows concerning this enterprise:

The contract for the construction of this road was let to the Montauk Construction Co., of New York City, who were to have the road completed by Jan. 1, 1891. Subsidies to the amount of about $150,000 were voted in aid of the road by the towns along the route, and preliminary surveys were made. It is feared that the franchises of the company will lapse on account of the construction company failing to keep its contract. The road was projected to run from Paducah, Ky., to Hickman, Ky., via Melburn, Clinton and Moscow. Among those interested in the enterprise were: W. T. Paxton, of Paducah, and C. L. Randle, of Hickman.

Cabarrus & Stanley.—John P. Ellis, of Concord, N. C., writes as follows concerning this enterprise:

Two surveys have been made for the road which is projected to run from Concord to Mt. Pleasant, N. C., a distance of 9 miles. The route is through a rolling country affording very easy work. The principal business of the road will be in general merchandise and agricultural produce from the country along the line. None of the right of way has been obtained, but no difficulty is expected from this source. Mt. Pleasant has subscribed $24,000 in aid of the enterprise. Estimates are now being made and it is expected everything will be ready for construction by July. Correspondence is solicited from contractors.

Birmingham, Jackson & Kansas City.—Robert Gates, of Memphis, Tenn., has given us the following information:

The surveys have been completed for this road from Jackson, Tenn., northwest, via Alamo and Friendship to Dyersburg, a distance of about 46 miles. The remainder of the line has not been located. The route is through a good agricultural country, and a good traffic is expected in cotton, wheat, corn, iron, lumber, coal and general merchandise. Nearly all the right of way has been secured, and about $150,000 of other local aid obtained. J. J. Williams, of Jackson, Tenn., is Chief Engineer.

Birmingham & Jones Valley.—Chartered in Alabama to build a railway from Birmingham to St. Clair Springs, Ala. Among the incorporators are: Chas. M. Shelly, E. Gerry Stevens, Jr., C. M. Boulden, of Birmingham, Ala., and Edmund W. Botker, of Uniontown.

Columbia, Geneva & Western.—Incorporated in Alabama to build a line of railway, by John T. Davis, W. C. Koonce, J. T. Darby, and A. D. Wood.

Burkesville & Northwestern.—The surveys have been completed for the line from Burkesville, Ky., to Horse Cave, Ky., 45.8 miles, and the line from Burkesville to Glasgow, Ky., 36 miles, will now be surveyed. It has not been decided which route will be chosen. As soon as the route is decided upon construction will probably begin. H. A. Genung, of Burkesville, Ky., is Chief Engineer.

Macon & Atlantic.—Press dispatches quote W. B. Sparks as confirming the report that a comstruction company with a capital stock of $1,000,000 has been formed to build a railway from Macon, Ga., to Savannah, Ga., or Port Royal, S. C. The company will probably be called the Macon & Savannah Construction Co. The officers will be; W. B. Sparks, President; Jefferson Lane, General Manager; and H. L. Jewett, Secretary and Treasurer.

Bennettsville & Society Hill.—The surveys have been completed for this road, which is projected to run from Bennettsville to Society Hill, S. C., 11 miles. J. J. Lucas of Society Hill, S. C., is President.

Thomasville, Silver Valley & Pee Dee.—J. T. Cramer or Pleasant C Thomas, both of Thomasville, N. C., can give information concerning this enterprise, which was mentioned in our issue of April 26.

Huntington & Big Sandy.—Surveys are in progress on this West Virginia railway, which is being built to connect the Norfolk & Western and the Ohio River railways.

Danielsville.—George F. Daniels or R. Russell, both of Danielsville, Ga., can give information concerning this railway, mentioned in our issue of April 26.

St. Sebastian Sugar Valley.—Chartered in Florida to build a railway 24 miles long in connection with the St. John's & St. Sebastian Canal Co.

Kentucky.—Bills have been introduced into the Kentucky Legislature incorporating the Paducah, Southern & Jackson R. R. Co., the Solyersville, Prestonburg & Norfolk Ry. Co., the Louisville, Somerset & Jellico Southern R. R. Co., the Prestonburg & Southern R. R. Co., the Cynthiana Western R. R. Co., the Louisville, St. Louis & Nashville Ry. Co., the Louisa & Southwestern R. R. Co., and the Princeton Belt Ry. Co.

Tygart's Valley & Elk River.—The citizens of Beverly, W. Va., have organized a company for the purpose of building a railway from Belington to Addison, W. Va. The capital stock is $20,000.

NORTHWEST.—Existing Roads.

Chicago, St. Paul & Kansas City.—A press dispatch from Des Moines, Ia., says:

"The Chicago, St. Paul & Kansas City Railway is closing negotiations for a large loan to be applied to the construction of a system of Western feeders. The first line which is to be built is from Peru, Iowa, to Omaha, Neb., which will give a line from Chicago to Omaha about 493 miles long, or only 5 miles longer than the shortest present line between Chicago and Omaha. The second line is from Savanna, 12 miles northeast of St. Joseph, to Omaha, through the rich blue grass region and stock country of southeastern Iowa. The third line is a short branch from Sheridan, half way between Peru and Savanna, west to Tarkio, which is about half way between Savanna and Omaha."

Chicago, Burlington & Quincy.—This company has issued a circular to its stockholders offering them the right to subscribe to an issue of $7,639,450 of bonds. The proceeds of the issue will be used in building about 100 miles of new road in Wyoming and in the vicinity of the Black Hills and to retire about $2,500,000 bonds falling due the present year. The requirements of the Chicago, Burlington & Quincy this year for new miscellaneous construction, such as stockyards, side tracks and terminals, equipment and improvements, are estimated at about $4,000,000. The building in the Black Hills will take about $2,500,000, making, with the bonds to be cancelled, requirements of about $9,000,000.—John Fitzgerald & Bro. of Lincoln, Neb., have the contract for grading the 108-mile extension to Deadwood, So. Dak. Work is now in progress and the road is to be completed by Nov. 1.

Missouri Pacific.—Work on the Kearney & Black Hills R. R. is being rapidly pushed. It is expected to have the line completed between Kearney and Callaway, Neb., by Aug. 15.

St. Louis, Alton & Springfield.—It is announced that the necessary money has been raised to carry out the required improvements on this road. The extension from Bates to Springfield is to be completed at once and also the line from Alton to Venice, Ill., making a through line to St. Louis, Mo. A large amount of work will be done on the line between Bates and Alton improving the roadbed and putting the road into first class condition.

Pacific Short Line.—We are informed that the contract for the construction of this road from O'Neill, Neb., to Ogden, Utah, has been let to Scullen & Steacy, of St. Louis, Mo., who will commence construction soon.

Toledo, St. Louis & Kansas City.—This company has purchased and will lay 1,500 tons of steel rails on the western division this season. A large amount of ballasting will be done also.

Chicago & Northwestern.—A press dispatch says that the contract has been let to construct an extension from Whitewood to Deadwood, So. Dak. Work, it is stated, will be commenced at once, and the road completed by Oct. 1.

Projects and Surveys.

Pana & Roodhouse.—J. C. Essick, of Pana, Ill., President, writes as follows concerning this enterprise:

The surveys have been completed for this road, which is projected to run from Pana, Ill., via Morrisonville, Girard, and Scottsville to Roodhouse, Ill., a distance of 70 miles. The route is through a highly cultivated section of the country, affording a very favorable route. The principal business of the road will be in coal, grain, hay, live stock, and general merchandise. Nearly all of the right of way has been secured. The company is now engaged in the preliminary work, looking toward an early commencement of construction.

Milwaukee Belt & Terminal.—Frederick W. Kalbfleisch, of 36 New street, New York City, President, has given us the following information concerning this enterprise:

The road is to run around the city of Milwaukee, Wis., with various branches, all in Milwaukee Co., a total length of 50 miles. Surveys are now in progress. The object of the road is to finish a belt line transfer for the various railway lines entering the city, and to furnish connections with the various wharves, elevators and factories in the city. The company was chartered in March, 1890.

Kewaunee, Green Bay & Western.—This company was formed some time ago to build a line of railway from Kewaunee to Green Bay, Wis. The object of the company is to connect the Green Bay, Winona & St. Paul R. R. with the Flint & Pere Marquette R. R., by building this line of railway and running a line of boats from Kewaunee to Ludington. The surveys for the railway have been commenced under the direction of S. B. Fisher, of Green Bay, Wis., Chief Engineer of the Milwaukee & Northern R. R. It is stated that the line when completed will be operated by the Delaware, Lackawanna & Western R. R. Co.

Fremont & Yankton.—Surveys are in progress for this road, which is projected to run from Fremont, Neb., to Yankton, So. Dak.

Hastings & Superior.—W. H. Fuller, of Hastings Neb., is making surveys for a line of railway from Hastings to Superior, Neb. He will prepare estimates of the cost of the road, which will be submitted to the officials Atchison, Topeka & Santa Fé R. R., with a view to inducing that company to build the line.

Rhinelander & Western.—This company has been chartered to build a railway from Rhinelander, Wis., to a point on the Chicago, Milwaukee & St. Paul R. R. Among the incorporators are: E. S. Shepard, Chas. Chafee, G. S. Coon, E. O. Brown and John Barnes.

SOUTHWEST—Existing Roads.

Missouri, Kansas & Texas.—The annual report of this company for the year of 1889, shows the following results from operations:

Gross earnings	$7,922,444
Operating expenses	5,363,328
Net earnings	$2,559,116

Projects and Surveys.

Little Rock Belt.—F. S. Ingoldsby, of Room 214 Allis Block, Little Rock, Ark., has given us the following information concerning the Belt Railway Co., chartered to build a belt line around the city of Little Rock:

The road is projected to run through the city of Little Rock, down the Arkansas River valley, to a point opposite Wrightsville, and thence west and north through Wrightsville back to Little Rock, a distance of 30 miles. The work is light; maximum grade 1.25 per cent., average excavation and embankment, 10,000 cu. yds. per mile. The principal business of the road will be in clay, iron, granite, and the general freight and passenger traffic. The preliminary surveys for the line have been completed. The company was incorporated Jan. 8, 1890. S. C. Martin, of Little Rock, is President.

Kansas City Connecting.—W. B. Knight, of Kansas City, Mo., Chief Engineer, with a corps of engineers, is making a survey for this projected road. The road will start at the southeast corner of Wyandotte Co., Kan., and run to Quindaro, with a 2,000 ft. tunnel through the bluffs between the Olathe and the Keefer roads. Thence the line will run through Kansas City, Kan., and Argentine, Kan., to the mouth of the Kansas River, and thence back around the cities of Kansas City, Kan., and Kansas City, Mo., to the starting point. J. Seymour Scott, of Kansas City, Mo., is President.

Tennessee, Arkansas & Texas.—The cities of Hot Springs, Ark., and Paris, Tex., have subscribed $50,000 and $70,000 respectively in aid of this road. The company contemplates the construction of a railway from Little Rock, Ark., to Paris, Tex., a distance of 130 miles.

Bellevue Valley.—Chartered in Missouri to build a railway from Iron Mountain Station to the Schneider stone quarry, a distance of 3¾ miles. Philip W. Schneider, of St. Louis, can give information.

Denison, Sherman & Dallas.—The officers of this company are: O. H. Osborn, of Fort Scott, Kan., President; R. C. Foster, of Denison, Tex., Vice-President, and A. S. Drew, of Denison, Secretary and Treasurer.

Leavenworth, Denver & Utah Short.—The old Denver Short Line R. R. Co., chartered in 1888, has been revived under the above name. The road is projected to run from Leavenworth, Kan., to Denver, Colo. There is little probability of the enterprise getting beyond the projected stage.

Gulf, Brazos Valley & Pacific.—It is announced that the necessary arrangements have been completed for the commencement of construction on the division between Mineral Wells and Henrietta.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—The Yakima & Pacific Coast R. R. Co. has been chartered in the interest of this company to build a line railway from North Yakima, Wash., along the Natchez River to Cowlitz Pass in the Cascade Mountains, and thence along the valleys of the Cowlitz and Chehalis rivers to a point on Shoalwater Bay, near South Bend, with branches from South Bend north to a point on the south side of Gray's Harbor, and south and west to Leadbeter Point on the Pacific Coast.—The contract for constructing the line from Pullman, on the Spokane & Palouse Branch to Lewiston, Idaho, has been let to Donald, Smith & Howe, of North Yakima, Wash. The length of the road will be about 72 miles, and the contract calls for its completion by Dec. 1. The rails and ties have already been contracted for.

Union Pacific.—A large force of men is at work clearing the right of way for the line from Tacoma to Olympia, Wash.

Projects and Surveys.

Townsend, Castle & White Sulphur Springs.—A company has been chartered in Montana to build a railway from Townsend up Sixteen Mile Creek to its head and thence branches to Castle and White Sulphur Springs. An effort will be made to induce the Northern Pacific R. R. Co. to build the line. If this cannot be done, it is stated that a company will be formed to construct it.

Wallace & Sunset.—Incorporated in Idaho to build a line of railway from Wallace, Idaho, up Nine Mile Creek to a point near the west fork, a distance of about5 miles.

FOREIGN.

Mexico.—Geo. T. Walker, of London, Eng., has a concession from the Mexican government for the construction of a railway from Mazidan, on the Pacific Coast, to Monterey, where connection will be made with the Mexican National Ry. The route will be through a naturally rich section of the country.

Mexican International.—A press dispatch from Lima, O., says:

An important deal was made here to-day, involving nearly $22,000,000 capital. W. J. Marks, the representative of a wealthy English syndicate; Major George H. Sisson, of New York; General G. Huss, of Chicago, and B. C. Faurot, of this city, are the men interested. It is the contract for the building of 1,350 miles of Mexican International R. R. from Deming, N. M. to Topolobampa Bay, on the Pacific Coast. The exact amount involved is $21,650,000.

Mexican Central.—The annual report of this company for the year 1889 shows the following results from operations:

Gross earnings	$6,337,225
Operating expenses	3,511,826
Net earnings	$2,825,399

Since the last annual meeting about 200 miles of new road have been constructed, and the entire Tampico line, uniting the main line with the Gulf of Mexico, has been completed. The work of connecting the bar by jetties was begun March 13, and it is expected to secure a depth of at east 16 ft. of navigable water through the bar before the close of the present year. By March 1, 1892, it is hoped that the jetties will be substantially completed, with a depth of 24 ft. of navigable water. The company is now receiving subsidy collections at the rate of 7 per cent. of the customs revenues for the current six months, and will be entitled to 8 per cent. after July 1. Only $3,300 company notes are now outstanding, and all the debentures have been paid except $54,000 not yet presented. The company has no floating debt.

RAPID TRANSIT.

Electric Railways.—An electric road is to be built between Dover and Great Falls, N. H.

At Salem, Mass., surveys are being made by Mr. C. A. Putnam for a road to Peabody, a distance of 4 miles. Storage battery cars will be used. The Salem & Lynn St. Ry Co. proposes to build an electric line between these towns.

The Buffalo, Tonawanda & Niagara Electric Ry. Co. has elected the following officers: President, S. B. Hard, of Englewood, N. J.; Vice-President, Herbert M. Curtis, of New York, N. Y.; Secretary, Clarence R. Dean, of Buffalo, N. Y.

The Pittsburg & Birmingham Traction Co., of Pittsburg, Pa., has been investigating the Thomson-Houston-Short, Julien and other electric systems. The storage battery is favorably considered.

The Tenleytown & Rockville Electric Ry. Co., of Rockville, Md., will build its line to Cedar Lane this year, and must complete it to Rockville in 3 years.

The Ashland & Catlettsburg St. Ry. Co., of Ashland, Ky., will operate its line by electricity.

The Home Electric Ry. Co. has been incorporated at Macon, Ga., by R. T. Lawton and W. B. Sparks. Capital stock, $50,000. The road will be 4½ miles long.

The National Home & North Greenfield Electric Ry. Co. has been incorporated at Milwaukee, Wis., by Paul Bechter, G. M. Hinckley and Wm. D. Gray. Capital stock, $100,000.

An electric railway at Yankton, Dak., is projected by Omaha parties. The line will be 6 miles long, and the plant will be driven by water power from artesian wells.

The People's Electric St. Ry Co., of St. Joseph, Mo., proposes to build an extension 5 miles long to Lake Contrary. It will cost $75,000.

The street railway at Hannibal, Mo., to be operated on the electric system.

At Salt Lake City, Utah, a number of street railways are being built, and others are projected. The West Side Rapid Transit Co. has applied for a franchise for an electric road.

The Port Townsend Belt Line Electric Ry. Co. has been incorporated at Port Townsend, Wash. President T. W. Pettigrove; Vice-President, Geo. S. Green: Treasurer, John Gagen. Capital stock, $150,000.

Cable Railways.—The St. Louis Cable & Western Ry., of St. Louis, Mo., is to be sold by Edward T. Farish, master in chancery.

The Tacoma St. Ry. & Motor Co., of Tacoma, Wash., will build a cable road on Thirteenth and Fifteen Sts.

The Piedmont Cable Co., of Oakland, Cal., has acquired the Blair St. line, and has been reorganized as the Consolidated Piedmont Cable Co.; with a capital stock of $2,000,000. The Fourteenth St line will be changed to the cable system.

At Dallas, Tex., the contract for a cable road to the Fair grounds has been awarded to the Pacific Cable Construction Co., of San Francisco, Cal. It will be a double track line, 3 miles long, and is to be completed by October.

Street Railways.—The Laconia & Lake Village St. Ry. of Laconia, N. H., has been purchased by Mr. Frank Jones.

At Syracuse, N. Y., a syndicate has acquired control of all the street railways, with the exception of the People's Line. The lines will be improved. Mr. Theodore L. Poole and Mr. F. C. Eddy are interested.

The street railways at Buffalo, N. Y., have been purchased by the Crosstown Ry. Co., of Rochester, N. Y., which is controlled by the Elkins and Widener syndicate, of Philadelphia.

The Union St. Ry. Co. has been organized at Elizabeth, N. J. Capital stock, $100,000.

A number of new lines and extensions are projected at Reading, Pa.

At Allegheny, Pa., the Terry St. Ry. Co. and the Allegheny & Bellevue St Ry Co. have been incorporated. Capital stock, $100,000 and $60,000 respectively.

The street railway at Muskegon, Mich., is to be extended to Lake Michigan.

The Chicago & Western Rapid Transit Co., of Chicago, Ill., has been organized by E. L. Kuhns, Joseph H. Defrees and A. F. Shuman. Capital stock, $8,000,000.

At Golden, Col., a franchise has been granted to the West End St. Ry. Co.

The Oregon St. Ry. Co., of Oregon City, Ore., has been incorporated by E. N. Atkinson, J. T. Apperson and N. O. Walden. Capital stock, $25,000.

HIGHWAYS.

Texas.—The Houston *Post* urges the continuance of the agitation of the road improvement question: The solution must be worked out by the people, and it can only be done by persistent and unceasing agitation. The bugbear of county bonds and excessive taxation should not frighten anybody who has the good of the State and the community at heart. The county roads can be systematically improved without the levying of an onerous tax, or the issuance of bonds in most if not all of the counties; but if some of the counties require the aid of bonds, and the property owners and taxpayers of such counties desire to tax themselves, why should the people of other counties object? The roads must be improved. There are various ways of accomplishing such improvement, and the easiest, best, and most economic method should be employed.

New York.—At a meeting of the Ulster Branch of the Farmers' League, held at New-Paltz recently, the Committee on Road Improvement reported the following radical recommendations: The absolute abolition of the present iniquitous and inefficient highway system, which is in every way offensive and subversive of the objects sought; highway work to be placed in charge of the town supervisors, a county superintendent of roads, to act in a capacity of supervisor, to make detailed reports annually; the passage of an act appropriating State funds amounting to 25 per cent. of the usual road appropriations in each town, in addition to the sum before raised. The State Farmers' League is requested to bring this matter to the attention of all the county leagues in the State, and take the necessary steps for holding a State conference on the subject of road improvement at an early day, at which every county shall be represented. The purpose is, after the general conference, to draft a simple practical bill to be presented to the next Legislature, which shall be pushed through with all the energy and influence the organized farmers of the State can command. Many of the bills on the subject now before the Legislature nominally were discussed, but all were found impracticable.

Virginia.—The U. S. Government will appropriate $11,000 to build a public road from Staunton to the Federal cemetery.

New Jersey.—The Montclair Township Committee has received the following bids for stone roads: Schafer & McDowell, 6-in. road, 71½ cts.; 8-in., 87 cts. T. M. Newins & Son, 85 and 98 cts. for 6 and 8 in. roads respectively. Wright & Lindsley, 75 and 95 cts. The Passaic County Board of Chosen Freeholders has awarded contracts for grading and macadamizing about 20 miles of the leading roads of the county within a radius of 8 miles of Paterson. The estimated cost is about $100,000, part of which will be met by the issue of bonds and the rest by taxation. Last year the county spent $62,000 in grading and macadamizing roads. Much attention has been given to improving the grades of some of the old country roads.

In our advertising columns will be found an advertisement for proposals for the following road work: 344 cu. yds. of excavation and 10,791 sq. yds. of Telford or macadam pavement; 2,592 cu. yds. and 19,228 sq. yds.; 2,225 cu. yds. and 15,413 sq. yds. For specifications, etc., address T. A. Dunham, Engineer of County Roads, 7 Park Ave., Plainfield, N. J. Proposals will be received until June 5 by J. T. Hubbard, Court House, Elizabeth, N.J.

WATER-WORKS.

NEW ENGLAND.

Newton, Mass.—Sealed proposals will be received by the Water Board at the City Hall, West Newton, until May 16, for the labor and materials required for building a masonry reservoir about 173 ft. by 115 ft., by 14 ft. deep, covered with brick arches, on Waban Hill. A certified check for $1,000 upon a National bank of the cities of Newton or Boston, drawn and made payable to the Treasurer of the City of Newton, must accompany each proposal. All proposals must be made out on blank forms furnished by the board. Address Albert F. Noyes, City Engineer.

East Hartford, Conn.—The water committee has reported adversely upon the proposition of the East Hartford Co.

Windsor Locks, Conn.—James W. Byrne, Town Clerk, has sent us the following:

At a meeting on May 5 the citizens voted to pay an annual rental of $750 for 28 hydrants, and $25 for each additional hydrant. The contract was made with the company for one year.

MIDDLE.

Cohoes, N. Y.—The bill authorizing the city to issue $25,000 of bonds has been signed by the Governor.

Yonkers, N. Y.—The common council will be asked by the Water Commissioners to issue $20,000 of bonds for the extension of mains.

Peekskill, N. Y.—The bill authorizing the city to issue bonds for extending the mains has passed the Senate.

Lockport, N. Y.—The Holly Mfg. Co. has delivered the new 5,000,000-gall. pump to the city.

Brooklyn, N. Y.—Commissioner Adams has recommended the construction of an additional distribution main from the Ridgewood reservoir to the western portion of the city. "The only way to have an adequate supply from the Navy Yard to Red Hook is to have an additional main 48 ins. and 36 ins. in diameter. He estimated the total cost at $694,210." The length of the proposed main is 6,900 ft.

Bellefonte, Pa.—About 1,000 ft. of 1½ pipe will be laid this season. Superintendent, Samuel D. Ryan.

Altoona, Pa.—About 1¼ miles of new mains will be laid this season, and 16 new hydrants, 20 valves and 7 meters will be set.

Lebanon, Pa.—About 1,000 ft. of 6-in. pipe will be laid this season, and 4 new hydrants and 3 valves will be set.

Turtle Creek, Wilmerding, Port Perry and Wallis, Pa.—The two large reservoirs of the East Pittsburgh Improvement Co., at Port Perry, built to supply these towns with, have been completed and put into use. A pumping station was completed some time ago. Water is pumped direct from the Monongahela River. The reservoirs are situated on the old Miller estate and have been in the course of construction about 7 months. They have a capacity of 40,000,000 galls., with a pumping power of 1,000,000 galls. per day.

Beaver Falls, Pa.—A citizen's vote will be taken on May 15 to decide the question of issuing $200,000 of the bonds for constructing works, etc.

SOUTHERN.

Glasgow, Va.—A. D. Exall, C. E., has sent us the following information:

A private company has awarded the following contracts for constructing works: Masonry, Hamm & Anderson; pipe and fittings, the Glamorgan Co., of Lynchburg, Va.; pipe-laying, James Allen, of Lynchburg, Va. Work was commenced on April 15, and is to be completed about June 15. Water will be obtained by gravity from a mountain stream. Estimated cost, $10,000 to $12,000. The storage reservoir is formed by building a dam across the gorge, and will have a capacity of 500,000 to 750,000 galls. The dam will be built of solid masonry, 75 ft. long on top, 45 ft. long at bottom. The foundation will be laid 10 ft below the original bed of the stream.

Buena Vista, Va.—The city is negotiating for the purchase of the company's works.

Florence, S. C.—The City Council is receiving plans and estimates for the construction of a stand-pipe, sinking an artesian well, laying 6 miles of pipe and placing 80 hydrants. Address the Mayor.

Atlanta, Ga.—City Attorneys Goodwin & Brown, in a communication addressed to Mayor John T. Glenn, state that there is doubt as to the validity of bonds issued by the authority granted by the special election, and recommend that further action be postponed until the next regular election, when a more general expression of the people could be secured.

Albany, Ga.—The City Council has ordered another election to vote upon the question of establishing works.

Gainesville, Ga.—A vote will be taken on June 3 to decide the question of issuing $40,000 of 30-year 6 per cent bonds, $30,000 of which to be used in constructing works.

DeLand, Fla.—The City Council has accepted the proposition of J. W. Starr, of Philadelphia, Pa., to establish works The plant will include a stand-pipe, 18 ft. in diameter by 110 ft. high, 3 miles of mains, and a pumping plant with a daily capacity for 1,500,000 galls., and an artesian well.

Nashville, Tenn.—The Board of Public Works and Affairs will receive proposals for a large quantity of pipe, specials, etc., and executing work, on May 15. For further information see our advertising columns. Plans, etc., can be obtained by addressing J. A. Jowett, City Engineer, or George Keyer, Superintendent.

South Pittsburg, Tenn.—It is now reported that the city works have been purchased by a company recently organized. The new company is making arrangements to build two 1,000,000 gall. reservoirs.

Chattanooga, Tenn.—The Crawfish Water Co. has applied to City Council for authority to lay water mains through the streets and supply water. They propose laying pipe from Crawfish Springs, Ga., to this city, a distance of 15 miles. The volume of water that flows from the spring is about 1,599,840 galls. per day. At the mouth of the main spring the water spreads into a large lake in which there are a number of other springs that doubles the volume of water, which is said to be ample to supply a population of 200,000.

Louisville, Ky.—A new 40-in. main is to be laid. The company proposes to issue $600,000 of bonds to carry out contemplated improvements.

Ashland, Ky.—H. Hermann, of New York, has organized a water-works company, and bound himself to advance $100,000 at once to build the works. A charter has been secured, and the city authorities and public generally are strongly in favor of the works.

NORTH CENTRAL.

Cincinnati, O.—Superintendent Willis P. Thorp has submitted a report to the Board of Public Improvement, outlining the present condition of the water-works. He recommends as a means of meeting the present demands, that new and additional pumping machinery be purchased and erected.—The Board of Public Improvement has since passed a resolution, requesting the Chamber of Commerce, Board of Trade and the Commercial Club to suggest the names of expert engineers, who would act as a consulting board to report upon the present needs and oversee the improvements.

New Lisbon, O.—C. F. Briggs, Secretary, informs us that about 4,000 ft. of 4-in. pipe will be laid this season, and that 10 new hydrants and 2 or 3 valves will be set.

Cincinnati, O.—The Addyston Pipe and Steel Co. has been awarded the contract for furnishing the city with pipe and specials during the coming year.

Warsaw, Ind.—Judge Woods has appointed W. H. Eggleston Receiver of the Warsaw Water-Works Co., and authorized him to borrow $23,000 to provide a new source of water supply, as the city is about to take away the company's franchise because water is obtained from a lake used during the summer for bathing. The appointment was made upon application of the American Loan and Trust Co., of New York. This corporation has also entered suit against the company, the Lake City Bank, and Charles Martindale, Trustee, to foreclose a first mortgage of $80,000 upon which interest has been defaulted.

Coldwater, Mich.—At a special election held on May 5 to settle the question of bonding the city for $70,000 to put in works, the question was carried by a majority vote of 296.

Detroit, Mich.—Bids for laying the new inlet pipe have been as follows: T. P. Sheehan, $7,997; P. W. Keating, $4,300; Macher & Breyman, $6,750; Thomas Davis, $4,594. P. W. Keating was the lowest bidder and was granted the contract. For supplying one 36-in., six 30-in., 12 4-in. and two 16-in. water gates: Galvin Valve & Hydrant Co. bid $5,190; James Flower & Bros., $7,005; Frontier Iron & Brass Works, $6,430; Murdock Valve Co., $5,815; Galvin Brass & Iron Works, $5,100. The contract was awarded to Galvin Brass & Iron Works.

Battle Creek, Mich.—Superintendent W. W. Brigden has sent us the following:

Fifteen new hydrants, 25 valves and 15 meters will be set this season, and 1½ miles of 6 and 8-in. pipe will be laid. A conduit for increasing the supply will be laid from Minges Brook to Gognac Lake.

Morrison, Ill.—Mayor A. P. Simpson has sent us the following:

The contract has been awarded to the Porter Boiler Mfg. Co., of Chicago, Ill., to build a tank with an iron roof, at $3,768.50.

NORTHWESTERN.

Schaller, Ia.—A small system of works is to be constructed.

Goodhue, Minn.—Money has been raised with which to sink an artesian well to supply the town with water.

St. Paul, Minn.—Ground upon which to construct a new pumping station has been purchased, and work on its construction will be commenced at once. As soon as completed pumps will be built and placed in position. Water is to be pumped from this station to supply the west side with water.

Superior, Minn.—Twenty-five miles of new gas and water mains will be laid this year. The West Superior Iron & Steel Co. has been awarded the contract for furnishing the pipe.

Junction City, Kan.—The city has let contracts for $3,800 for extending mains.

Ainsworth, Neb.—C. H. Godfrey, of Fremont, Neb., was awarded the contract for constructing works, to be completed by July 1, on May 2.

Oxford, Neb.—Works are projected. Address the Town Clerk.

Crete, Neb.—Johnston & Stevens have sold their franchise of the city works to H. G. H. Tarr & Co. The new company will probably lay about 2 miles of pipe and make other improvements.

Winside, Neb.—We have received the following information:

The U. S. Wind Engine & Pump Co. and Crane Bros., of Omaha, Neb., are the contractors for the new works. All the material has been purchased. The works are being built for the Winside Water-Works Co. Water will be pumped from wells to a reservoir.

Miles City, Mont.—City Clerk S. Gordon has sent us the following:

The Miles City Water & Electric Light Co. is to establish works, and has awarded the contract for material to Rogers & Ordway, of St. Paul, and for pumping machinery to Henry R. Worthington, and for construction to J. M. Bucknel. Work will be commenced on May 20, and is to be completed about July 1. The supply will be furnished by 2-in. driven wells. President, E. R. Gilman, of St. Paul, Minn.; Vice-President, H. F. Batchelder; Superintendent, B. Ullman. Engineer in charge, George Sheetz.

Livingston, Mont.—The city has contracted with the water company for 25 hydrants. It is expected that the new works will be in operation about May 15.

SOUTHWESTERN.

Austin, Tex.—The proposition to bond the city for $1,400,000 for damming the Colorado river for securing a water supply for water-works and other purposes, resulted in a practically unanimous vote being cast in favor of the proposition.

Sulphur Springs, Tex.—Steps are to be taken to establish works. Address the Mayor.

Round Rock, Tex.—It is proposed to sink an artesian well to secure a water supply for the town.

Boulder, Colo.—Ripley & Bronson, of St. Louis, Mo., were awarded the contract for furnishing the pipe for the new works on April 28. About 2,000 tons will be required. Bids were asked on April 29 for trenching and pipe-laying.

PACIFIC.

Spokane Falls, Wash.—Press dispatches state that high water has washed away a considerable amount of mains.

Port Townsend, Wash.—The Mount Olympus Water Co. has announced that bids will be received for furnishing the pipe and other materials necessary for extending the system, as well as clearing the right of way and the putting all the material on the ground. Engineer Keifer, of Vancouver, B. C., has been engaged by the company to make estimates for future work, and to prepare detailed specifications for the completion of the works.

North Yakima, Wash.—F. S. Woodward, Secretary of the Yakima Water Co., has sent us the following:

The works of the Yakima Water Co. will be put in operation about July 15. Work was commenced on March 20. Water is furnished by gravity, and by direct pumping, from the Natches River. The two pumps, 1,500,000 galls. capacity, respectively, were furnished by the Holly Mfg. Co., through Philip Buehner, of Portland, Ore., their Western agent. Pipe and specials were furnished by the Oregon Iron & Steel Co., of Portland, Ore. Hydrants, Mathews; valves, Eddy. There are 30 hydrants, and 6¼ miles of mains. Cost, $150,000. The officers are: President, Edward Whitson; Secretary and Superintendent, F. S. Woodward; Treasurer, W. L. Steinweg; Engineers, F. W. Smith and Philip Buehner, Portland, Ore. Population, 3,100.

The Dalles, Ore.—The Council has accepted the bid of J. F. Houghton for $100,000 of bonds at 6 per cent., with a bonus of $1,100. A new water supply is to be established.

Mount Tabor, Ore.—The Mount Tabor Water and Electric Light Co. will establish works. Steam power will operate the pumps during the day and dynamos will furnish motive power at night.

Woodlawn, Ore. (A suburb of Portland, Ore.)—The Tumwater Pipe Works, near Olympia, Wash., has been awarded the contract for furnishing the pipe for the extensions. About 3 miles of pipe will be required. The new pump for supplying this town with water has been put into operation.

Albina, Ore.—About 7 miles of new mains will be laid this season, instead of 5 miles, as originally proposed. The old 4-in. mains are being replaced by 10-in. mains, and the new supply well has reached a depth of 70 ft. The improvements are being made by the Albina Light and Water Co.

San Francisco, Cal.—A. C. Douglass, of New York, and L. A. Riley & Co., have been awarded the contract for constructing a 7,000 ft. tunnel, to be used in supplying the city with water.

Alameda, Cal.—E. B. Mastick, Chairman of the City Trustees, has expressed himself in favor of purchasing the works, if they can be obtained for $350,000, from R. R. Thompson, and making the necessary enlargements of the plant.

Ogden, Utah.—Elwood Mead, Chief Engineer of the Bear Lake & River Water-Works & Irrigation Co., informs us that the following bids for excavation, etc., have been received, and that the contract was awarded to Campbell & Woodson, April 30:

Bidders.	Excavating in streets per lin. ft.		Refilling Trenches in streets p r lin. ft.	Digging Bellholes in street trenches per bellhole.	Ditch excavation for 24-in. pipe conduit per cu. yd.			Refilling ditch in Ogden Cañon per lin. ft.	Digging Bellholes in 24-in Supply Main per Bellhole.	
	4 ft. deep.	3½ ft. deep.			Solid Rock.	Loose Rock.	E'r'h.		Solid Rock.	Loose Rock and Earth.
Carroll & Donohue, Ogden, Utah	$0.09¾	$0.09	$0.05	$0.29	$1 50	$0.60	$0.30	$0.11	$6.	$1.50
Wm. Garland, Collinston, Utah	0.10½	0.09¼	0.05½	0.25	0.89	0.39	0 20	0.14	2.25	0.75 & 0.35
Keating Bros. & Co. Pittsburg, Pa. (Excavation and refilling per ft.)				0.90	0.70	0.33	0.14⅛			
Campbell & Wood, Buena Vista, Colo.	0.08	0.07½	0.04	0.10 & 0.15	1.45	0.35	0.23	0.09	5.	0.75
Joseph Johndrew & Co., Ogden, Utah	0.80	0.65	0 11	1 25	2.	1.	0.90	0.30	10.	2.
Carey Bros. & Co., Ogden, Utah	0.09½	0.08½	0.05½	0.60	2.	0.60	0.30	0.30	10.	2.
Luke Voorhees, Cheyenne, Wyo	0.16	0.14	0 07	0.40						
Frank Julian & Co, Ogden, Utah	0 35	0.30	0.10	3.	7.50	3.	0.35	0.75	10.	4.
Wm. Dunbar, Ogden, Utah	0.09½	0.09	0.04½	0.18						

CANADA.

Springhill, N. S.—The Mayor and Town Council have been authorized to make all necessary arrangements for supplying the town with water. Several attempts have been made by private companies to establish works, but public sentiment has always defeated such projects. The present plan is for the town to construct and maintain its own plant.

Windsor, Ont.—Alderman Fleming's by-law asking for $40,000 for water-works purposes, has passed its third reading in the City Council. It will be submitted on June 11.

Galt, Ont.—We have received the following information:

The Water-Works Committee has engaged Willis Chipman, M. Am. Soc. C. E., of Toronto, Ont., to report upon a system of works. Several of sources of supply will be investigated.

Toronto, Ont.—The following recommendation has been made by the Water Department:

I would again draw the attention of the committee to the large amount of water pumped daily, even at this season of the year, and the necessity of increasing the pumping capacity of this station. We have, as I previously reported: No. 1 Worthington, daily capacity 4,000,000 galls.; No. 2 Worthington, daily capacity 8,000,000 galls.; No. 3, Ingles & Hunter, daily capacity 9,000,000 galls. If anything should happen to the large engine we would have to draw the balance from the reservoir, and the supply stored there would not last very long in the hot weather. I would, therefore, advise taking out No. 1 Worthington and replacing it with a high duty 8,000,000 or 10,000,000-gall. engine as soon as possible.

The Superintendent has recommended that stop-valve contract be awarded to John Perkins at $3,000.

Winnipeg, Manitoba—City Engineer H. N. Ruttan has submitted a special report to the Committee on Public Works in which he alleges that the company is not fulfilling the conditions of the contract under which the charter was granted. In concluding his report he states:

It may be pointed out that with a satisfactory water service, such as in use in other places (see table, *A* and *B* in report of April 8, 1887), the city would be saved one-half the cost of the present fire brigade and have a more efficient service. It would also save the large and unsatisfactory expenditure now necessary for the construction and maintenance of tanks.

ARTESIAN WELLS.

Beresford, So. Dak.—The well has been abandoned at a depth of 200 ft., because of the breaking of the tools. A new well will be started.

Santa Fe, N. M.—Wells will probably be sunk by the U. S. Government to supply the Indian schools with water. Address Thomas J. Morgan, Commissioner of Indian Affairs Washington, D. C.

Franklin, Va.—A well sunk by J. H. Bogart and J. R. Knight is furnishing a good supply of water at a depth of 135 ft. This is the ninth well already put down by individuals.

IRRIGATION.

Ogden, Utah.—The Bear River Canal Co. is contracting for 50 miles of canal on the west side of Bear River. It is all earth work, being the continuation of the canal from the rock work. The canal is to be 30 ft. wide at the bottom, 50 ft. wide on top and 7 ft. deep. The total length of the canal will be 150 miles.

Denver, Col.—The Watkins Canal and Conduit Co. and the Happy Thought Ditch Co., both organizations deriving their supply of water from the Box Elder Creek, in Arapahoe County, have been consolidated.—The Needle Rock Ditch Co. has been organized with a capital of $4,200, and filed articles of incorporation with the State Secretary. The company will operate in Delta County, and will build an irrigating ditch from Smith's Forks of the Gunnison River through Delta County and vicinity.

East Dale, Colo.—The East Dale Land, Canal and Reservoir Co. has been incorporated with a capital stock of $20,000. The company has been organized for the purpose of building towns, irrigating arid lands, and will do a general land and real estate business. It will build and control an irrigating ditch in Costilla County, which will be supplied from the Costilla River.

Idaho.—The Payotte Irrigating Co. has filed articles of incorporation with the Territorial Secretary. The capital stock is $25,000.

Dakota.—The success of the artesian well at Huron, So. Dak., has led to the formation of an irrigating company in Spink County. A. W. Bowman is the President. Arrangements have been made for sinking a number of wells, and contracts for boring six have been let. The wells are to cost $1,600 each, provided none are made deeper than 1,000 ft. Work will be begun at once.

Blackfoot, Idaho.—A Government engineering corps is making a survey with a view to irrigating on the desert between Blackfoot and Root Hog.

San Angelo, Tex.—Ostrander & Loomis are having a survey made of their ranch preparatory to constructing an irrigating ditch to be 20 miles long. Water will be taken from the Concho River 8 miles below town. Estimated cost, $200,000.

Lookout, N. M.—The Lucas Ditch Co. has been incorporated; capital stock, $1,000. The directors are: D. H. Lucas, T. D. Lucas, J. G. Lucas. Its object is to construct, own, maintain and operate a ditch for irrigating agricultural lands in parts of sections 13, 17, 24 and 25, township 25 south, range 25 east, Lincoln County.

SEWERAGE AND MUNICIPAL.

Sewerage.—The Drainage Committee of the Massachusetts Senate has reported a bill to authorize the city of Pittsfield to construct a system of sewerage and to provide for the payment therefor. The bill authorizes the appointment by the Mayor of three commissioners of sewers. The county of Berkshire shall pay expenses for sewers connected with county buildings upon terms agreed between the county commissioners and the sewer commissioners, and the county commissioners are authorized to build a sewer to connect with the main trunk sewers authorized by this act. The Pittsfield City Council is to fix the pay of the sewerage commissioners, and the city is authorized to issue bonds to the amount of $400,000, payable within forty years and bearing not over 5 per cent. interest. The act is to be submitted for acceptance to popular vote.

Engineer Root, of Westfield, Mass., has completed the plans and profiles for the sewers to be laid the coming summer, and the selectmen will receive proposals until May 15 for the construction of 12,000 to 15,000 ft. of sewers.

At Mt. Vernon, N. Y., $60,000 are to be spent on the construction of lateral sewers.

Plans and estimates for the sewerage of Orange, N. J., have been prepared for the Common Council by Mr. C. Ph. Bassett, M. Am. Soc. C. E. It is thought that there will be no complaints from Newark and Jersey City, as the outlet into the Passaic River will be a mile below the pumping station. The estimated flow of water in the Passaic river at this point during the dry season is over 125,000,000 galls. per day. The estimated out-put of sewage from Orange would be, at present, 1,250,000 galls. daily. By the time the Orange sewerage system is completed, Newark will have its new water supply. The construction of a storage chamber at the outlet of the main is also considered, which would collect the sewage for 12 hours and discharge only at ebb tide. The system will cost between $450,000 and $500,000.

The city of Knoxville, Tenn., has decided to put in a system of sewers, and an appropriation of $2,500 has been made for the necessary surveys.

At Hastings, Neb., it has been voted at public election to issue bonds for a sewerage system.

At Salt Lake City, Utah, the big sewer pump throwing 1,200 galls. per minute is at work, and sewer connections are being made, so that at last the city is having its long-needed sewerage system. The sewage is pumped over the Jordan a mile or two into the surplus canal.

Mr. Willis Chipman, M. Am. Soc. C. E., has been engaged by the Council of West Toronto Junction, a suburb of Toronto, Ont., to prepare a report on a system of sewerage. A population of 50,000 is to be provided for.

The by-law submitted to the freeholders of Brantford, Ont., April 25, to raise $80,000 for the construction of a main sewer and to aid in the construction of sub-mains and laterals was carried by a large majority. The plans and system were designed by Mr. Willis Chipman, M. Am. Soc. C. E., of Toronto, Ont.

Street Work.—At Mount Vernon, N. Y., the Board of Trustees will spend $100,000 in improving the avenues.

At Allegheny, Pa., an ordinance has been introduced providing for the paving with Belgian or ligonier block all streets traversed by the Pittsburg, Allegheny & Manchester Ry. Co.'s lines. The company was several months ago granted the privilege to use electricity or cable as motive power on all its lines, under the condition that it should pave the street between the tracks, and one foot on each side of them, with Belgian or ligonier blocks. This ordinance covers five miles of street.

At West Cleveland, O., the contract for paving Detroit St. has been forfeited and new bids will be received. The work will cost $10,0000.

At Grand Rapids, Mich., the Common Council has passed resolutions to pave Canal and Sheldon Sts. with sheet asphalt on concrete foundation, and estimates have been ordered made for the same paving on West Bridge St.

At St. Louis, Mo., contracts for street improvements have been awarded by the Board of Public Improvements amounting to $107,028.65. Of this sum, $51,952.20 is to be expended for three Telford streets, $3,441.20 for one macadam street, $13,344.40 for two partially improved streets, $5,256.25 for grading eleven streets, $8,013 80 for grading and paving three alleys, $24,324 for granite reconstruction of eleven alleys.

Gas Lighting.—The Gas Commission, New York, has awarded contracts for the year beginning May 1. The Consolidated Gas Co. is to light 17,150 lamps at $17.50 per lamp per year; the Mutual Co 280 lamps at the same rate; the Central Co. 2,675 lamps at $27; the Northern Co. 2,200 lamps at $23; New York & New Jersey Co. 126 lamps at $22.50; the Yonkers Co. 557 lamps at $28. The higher rates are for lighting the annexed districts.

The Union Gas Co., of Nashville, Tenn., has been organized by W. F. McCully and others. Capital stock, $200,000.

The new gas works at Hamilton, O., have been completed. They cost $150,000.

Water Power.—Mr. J. F. Hart, of Yorkville, and Mr. J. L. Black, of Blacksburg S. C., are said to have purchased the water-power at Ninety-Nine Islands on Broad river. They propose to organize a stock company for its development.

ELECTRICAL.

Electric Lighting.—The Susquehanna Electric Light, Heat & Power Co., of Susquehanna, Pa., has elected the following officers: President, J. G. Brewer; Vice-President, W. S. Mitchell; Secretary, A. W. Cook. A Westinghouse plant is to be put in.

Proposals for an electric light plant for Camden, S. C., will be received by W. E. Glenn until May 15.

At Brunswick, Ga., the electric light company will spend $50,000 in improvements to its plant.

The Carrollton Electric Light & Power Co., of Carrollton, Ga., has been organized by G. T. Quackenbush, of Tallapoosa; S. P. Mandeville and H. O. Roof.

The Pell City Iron & Land Co., of Pell City, Ala., will put in an electric light plant.

An electric lighting franchise, for 20 years, has been granted to I. C. Towner, of Elgin, Ill., who representsa company with a capital stock of $100,000. Light and power plant will be put in this summer.

The Mount Tabor Water & Electric Light Co. will put in a plant. A steam engine will drive the water-works pumps during the day and the dynamos at night.

Electric light is wanted at Greenville, Tex., For particulars address the mayor.

At Sulphur Springs, Tex., arangements are being made to put in an electric light plant. For particulars address the mayor.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—*Fort Coulonge, P. Q.*—The plans for the proposed bridge across the Ottawa River between the Provinces of Ontario and Quebec have been completed. The bridge will be 1,735 ft. long, and is estimated to cost about $60,000.

Deering, Me.—Proposals will be received until May 12 for the masonry of the Stroudswater bridge. Also proposals are asked for a 50-ft. iron bridge. J. F. Clark, Deering, Me.

Warren, R. I.—Preparations are being made for the early commencement of construction on the proposed bridge at this place described in our issue of April 5. The King Bridge Co., of Cleveland, O., have the contract.

Franklinville, N. Y.—At a meeting of the Town Board, April 26, Highway Commissioner Towne was empowered to build an iron bridge in the western part of the town. The cost for the superstructure will be about $450 and for the stone work $125. It has not yet been decided whether to receive sealed bids or to sell the contract at auction.

New York, N. Y.—The Board of Estimate yesterday approved the plans for the construction of the proposed viaduct from Seventh Ave. at the McComb's Dam bridge to St. Nicholas Place, on Washington Heights, and Public Works Commissioner Gilroy was instructed to advertise for building proposals. The viaduct will cost about $600,000.—On the recommendation of Superintendent Parsons, of the Park Department, the Board appropriated $12,000 for rebuilding the bridge opposite Eighth Ave. and One-hundredth St., in Central Park. The Superintendent represented the old bridge as in an extremely dangerous condition.

Allegheny Suspension Bridge Co.—A meeting of the stockholders of this company will be held May 30, to consider the question of the capital stock to enable the company to renew and extend the construction of its bridge.

Dingman's Ferry, Pa.—A company has been organized to build an iron bridge over the Delaware River at this place. It will be about 530 ft. long and will cost about $15,000. J. N. Miller, of Centerville, Pa., is interested.

Dravosburg, Pa.—The iron bridge at this place has been completed and opened for traffic. The iron was contracted for by the Keystone Bridge Co. and sub-let to McConley & Morse. The piers were built by McDonald & Jutta, and the engineer was S. C. Weiskoff. The directors of the bridge are: W. P. Wampler, Robert Reynolds, Thomas Reynolds, S. S. Crump and John M. Risher. The officers are: John M. Risher, President; Thomas Reynolds, Vice-President, and W. J. E. McLain, Secretary and Treasurer.

McKeesport, Pa.—An application has been made for a charter to build a bridge over the Youghiogheny River at this place. Thos. Moore and David Lynch are interested.

Buena Vista, Va.—It is stated that the County Commissioners have decided to construct an iron bridge over South River, near the old Buena Vista furnace, and have appointed a committee to receive proposals and contract for the same. D. C. Humphreys can give information

Goshen Bridge, Va.—The County Commissioners have ordered that an iron bridge be constructed over Big Calf Pasture River at this place, and have appointed a committee to receive proposals and contract for the same. D. C. Humphreys can give information.

Lynchburg, Va.—The Rivermont Improvement Co., of Lynchburg, Va., is having surveys made for an extensive highway bridge to connect North Lynchburg with Lynchburg proper. The scheme contemplates a bridge 60 ft. wide, 1,000 ft. long and about 105 ft. above the water. R. Taylor Gleaves, of Lynchburg, Va., has charge of the bridge.

Peoria & Pekin Union Ry.—It is announced that this company will rebuild the bridges at Peoria, Ill., and Pekin, Ill. The present structures are too light for the heavier class of locomotives.

La Crosse, Wis.—Work has been commenced on the steel drawbridge across the Mississippi River at this place.

Yankton, So. Dak.—A Stock company is being formed at Yankton, So. Dak., to build a pontoon bridge across the Missouri River.

Nebraska City, Neb.—The Union Bridge Co., of New York, has submitted to the city a proposition to erect and maintain the proposed high wagon bridge across the Missouri River for a cash bonus of $50,000. This makes the fourth proposition received. The Phœnix Co. asks $100,000 bonus, while the King Bridge Co. has not yet decided upon the amount to ask for. Col. S. T. Stewart offers to put in a crib bridge for a bonus of $25,000.

St. Louis, Mo.—The Merchants' Bridge was formally opened for traffic on May 3.

Arkansas Post, Ark.—The President has approved the bill providing for the construction of a bridge across the White River at this place.

Toston, Mont.—The County Commissioners of Jefferson County will build a bridge across the Missouri River.

Townsend, Mont.—The County Commissioners of Meagher County, Mont., will build a bridge across the Missouri River at this place.

Dayton, Wash.—A bridge is to be built across the Yamhill River at this place.

Salem, Ore.—It is stated that Hoffman & Bates will get the contract for the new steel bridge at this place. The structure will cost $71,000.

Humboldt Co., Cal.—The Board of Supervisors of this county will receive bids for the construction of a bridge across Eel River at Alder Point, until July 15. Address O. D. Stern, Clerk, Eureka, Cal.

CONTRACTING.

Public Buildings.—The contract for a public building at Red Wing, Minn., has been awarded by the County Commissioners to Chas. Hagland & Co. at $11,000.

Plans and specifications have been prepared for a new court house at Fayette, Tex.

Jefferson County, Neb., has voted $60,000 in lands for building a court house at Fairbury.

It is proposed to build a county court house at Dickinson, Ia., at a cost of $15,000.

A vote will be taken May 26 at Pender, Neb., on the issue of $24,000 in bonds for a new court house.

Sewers.—At Boston, Mass., the Board of Metropolitan Sewer Commissioners have received the following proposals for Sections 3, 4, 5 and 6 of the improved sewerage. The contract for Section 3 has been awarded to R. A. Malone & Co., and the contracts for Sections 4, 5 and 6 to the Metropolitan Construction Co.

SECTION 3.

Richard A. Malone, Philadelphia	$74,297.00
Everson & Liddle, Yonkers, N. Y.	80,142.60
Metropolitan Const. Co., Boston	82,973 50

SECTION 4.

Metropolitan Const. Co	$138,222.00
R. A. Malone & Co	155,730.00
George L. Nichols, Cambridge	159,553.00
Everson & Liddle	160,753.00
National Const. Co., Boston	171,559.00

SECTION 5.

Metropolitan Const. Co	$136,931 50
Moulton, Mahoney & Trumbull, Lawrence	154,576.50
Geo. L. Nichols	157,913.00
R. A. Malone & Co	166,135.00
National Const. Co	168,092.50
Webster, Dixon & Co., Chelsea	174,492.00
D. H. Cram, Boston	187,625.50
J. Cavanaugh & Co., Boston	189,770.00

SECTION 6.

Metropolitan Const. Co	$98,085.70
R. A. Malone & Co	99,282.00
D. H. Cram	104,405.00
Everson & Liddle	110,117.50
National Const. Co	113,652.25
Moulton, Mahoney & Trumbull	111,851.50
Webster, Dixon & Co	125,036 70
Dennis O'Connell, Dorchester	183,747.00

At Los Angeles, Cal., the following proposals have been received for the brick central intercepting sewer:

Section 1.—Charles Bell, $5.61; Frick Bros., $5.14 and $5.10; R. G. Simmons, $8.48; Frank Walker, $6.89 and $7.50; W. A. Doyle, $6.57; T. T. Joyce, $7; John R. Hunter, $6.86; John McQuilken, $10.75; M. Zuretti, $5.55.

Sec. 2.—Charles Bell, $4.93; Frick Bros., $4.93 and $4.90; R. G. Simmons, $8.31; Frank Walker, $6.37 and $5.88; W. A. Doyle, $5.65; T. F. Joyce, $6; John R. Hunter, $6.36.

Sec. 3.—Charles Bell, $4.62; Frick Bros., $4.53 and $4.52; R. G. Simmons, $8.68; Frank Walker, $5.99 and $6.47; W. A. Doyle, $5.49; T. F. Joyce, $5.50; John R. Hunter, $5.95.

Extra excavating.—Charles Bell, 75 cts.; Frick Bros., 45 cts.; W. A. Doyle, 25 cts.; John R. Hunter, 50 cts.

Stone and Sand.—The Board of Docks, New York City, has awarded a contract for 500 cu. yds. of broken stone to A. J. Howell at $1.74 per cu. yd.; John A. Bouker bid $1.80. A contract for 700 cu. yds. of sand was awarded to John A. Bouker at 90 cts. per cu. yd.

Paving Blocks.—The following proposals for 121,000 Belgian blocks has been received by the City Commissioner, Baltimore, Md.: McClenahan Bros., $64.50 per 1,000; Guilford & Waltersville Granite Co., 40,000 at $64.40, 40,000 at $66.90, 41,000 at $69.40. W. T. Weller, 50,000 at $67.50, 50,000 at $65.60, 21,000 at $60.

The Board of Docks, New York City, has awarded a contract for 3,000 granite paving blocks to Chas. Guidet at $144.75 per 1,000.

Levees.—The Board of Mississippi Levee Commissioners at Greenville, Miss., proposes to issue $200,000 in bonds for maintaining and repairing levees.

Sewer Pipe.—The contract for sewer pipe for the village of Lakeside, Minn., has been let to F. W. Hatfield, of St. Paul, representing Evans & Howard, of St. Louis, Mo. The prices are as follows: 12-in., 22 cts.; 10-in., 17 cts.; 8-in., 10½ cts.; 6-in., 9 cts.; 8 to 6-in. Ys, 40 cts.; 10 to 6-in. Ys, 68 cts; curves, 25 cts.

Street Work.—The Commissioner of Public Works, New York City, has awarded contracts as follows: For asphalt paving on concrete foundation—On 8th Ave., 34th to 59th St., M. Taylor & Co., $4.99 per sq. yd.—$135,558; 8th Ave., 34th to 13th St., M. Taylor & Co., $3.94—$114,464; 53th St., etc., Barber Asphalt Paving Co., $4.85—$31,810. For asphalt paving on present stone block pavement, five contracts, all to the Barber Asphalt Paving Co., at $3.62 per sq. yd., aggregating $175,116. The contracts are on a 15-years guarantee. For granite block paving on concrete foundation: Greenwich St., Wm. Kelly, $19,031; Canal St., Matthew Baird, $3.73 per yd.—$109,072; Park Row, Matthew Baird, $4.17—$31,629; Harrison St., J. G. Smith, $3.93—$16,828.60; South William St., M. Gerrity, $3.93—$25,477.50; Elizabeth St., M. Baird, $3.43—$15,400; Catharine St., Wm. Kelly, $3.93—$14,900; Pearl St., $5.83—$51,340; East Broadway, M. Baird, $3.73—$70,092.50.

The Board of Public Works, Milwaukee, Wis., has awarded contracts as follows: Grading, 10, 18 and 21 cents per cu. yd.; curbing, 9½ and 11 cents per lin. ft.; sidewalks, 23¼ and 25 cents per lin. ft.

Mr. C. S. Brackenridge, City Engineer, Fort Wayne, Ind., has awarded a contract for 70,000 sq. yds. of cedar block pavement to the Talbot Paving Co., of Detroit, Mich., at 74 cents per sq. yd.; also 34 cents per lin. ft. for Berea curb. The total cost will be about $70,000.

PROPOSALS OPEN.

Street Work.—Regulating and granite block paving. The Commissioner of Public Works, 31 Chambers St., New York, N. Y. May 14.

Water-Works.—Pipe, specials, valves, gates, pipe-laying, constructing intake, etc. Geo. Reyer, Superintendent of Water-Works, Nashville, Tenn. May 15.

Station.—Union station, at Bristol, Tenn.; brick and stone. Chas. S. Churchill, Engineer of Maintenance of Way, Norfolk & Western R. R., Roanoke, Va. May 15.

Sewers.—Constructing 12,000 to 15,000 ft. of sewer. The Board of Selectmen, Westfield, Mass. May 15.

Street Work.—Granite block pavement; cross-walks and curbstones. The Paving Commission, Troy, N. Y. May 15. The Contracting Board, Troy, N. Y. May 16.

Sewer.—In District No. 29. J. P. Adams, Commissioner of City Works, Brooklyn, N. Y. May 16.

Courthouse.—Architect, F. E. Davis, Baltimore, Md. F. M. Griffith, Clerk of County Commissioners, Rockville, Md. May 19.

Bridge.—Iron or steel, with 3-in. plank flooring, one span, 34 ft. between abutments; 16-ft. roadway, 5-ft. sidewalk; capacity of roadway and sidewalk, 100 lbs. and 60 lbs. per sq. ft. respectively. The Board of Selectmen, Milford, N. H. May 21.

Sewers.—C. G. Force, City Engineer, Cleveland, O. May 23.

Road Work.—About 800 ft. of road on the Presidio military reservation. M. I. Ludington, Dep. Q. M., U. S. A., San Francisco, Cal. May 28.

Subway.—On Keele St., West Toronto Junction, under the Canadian Pacific Ry. tracks. James Percy, Chairman of Board of Works, West Toronto Junction, Ont. May 31.

Electric Light Plant.—T. J. Gillam, Morganton, N. C. June 1.

Bridge.—Substructure and iron superstructure of a bridge over the Cuyahoga River at Red Lock. Superstructure to consist of one span 8-panel high truss iron bridge, 120 ft. extreme length, by 14 ft. clear roadway, by 19 ft. in height from centers; floor beams to be riveted to posts, and joists so placed that bottom of floor will be common with top of floor beam. Capacity of bridge to be 1,400 lbs. per lin. ft., 12,500 lbs. tensile and 10,000 lbs. compression, Gordon's formula. Bids will also be received for a wooden superstructure, same span and roadway as above. Substructure to consist of two stone abutments, with necessary timber foundation, grading, pile driving, etc., according to plans and specifications on file in the office of C. E. Perkins, County Engineer, Akron, O. The County Auditor, Cleveland, O. June 5.

Bridge.—Plans, specifications, strain sheets, etc. O. D Stern, County Clerk, Eureka, Cal. July 15.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., are completing an order of 40 engines for the Georgia Central; 20 will be delivered this month and 20 in July. Of the first lot of engines, 16 will be freight engines with 18 x 24-in. cylinders, 2 will be passenger engines with 17 x 24-in. cylinders, and 2 will be shifting engines with 18 x 24-in. cylinders. In the second lot there will be 14 freight engines with 19 x 24-in cylinders, 4 passenger engines of 18 x 24-in. cylinders, and 2 shifting engines with 18 x 24-in. cylinders. These locomotives weigh as much as 115,000 lbs. They cost about $8,000 apiece, or $320,000 for the entire lot.

The Brooks Locomotive Works, of Dunkirk, N. Y., have delivered 5 mogul freight engines, with cylinders 18x24 ins., to the New York, Chicago & St. Louis. They are building 10 ten-wheel engines for the Wisconsin Central.

The Lehigh Valley Railroad has recently completed a new passenger engine at its Hazleton shops, from designs by David Clark, master mechanic. The locomotive has 20x24-in. cylinders and 5 ft. 8-in. drivers. It weighs 107,072 lbs. The weight on the drivers is 76,832 lbs., and on the trucks 30,240 lbs.

The Chicago, St. Paul & Kansas City R. R. will add 20 engines to its equipment.

The engines for the elevated railway at Sioux City, Ia., will be of the same pattern as those used on the New York road. They are constructed to burn only hard coal, thus avoiding the nuisance of smoke. They will have inclosed fire boxes, so that there will be no cinders to fall into the streets below, and the exhaust will be noiseless.

Cars.—The Jackson & Sharp Co., of Wilmington, Del., has built two passenger cars for the West Virginia Central.

The Terre Haute Car Works, of Terre Haute, Ind., have built 100 furniture cars for the Cleveland, Chicago, Cincinnati & St. Louis.

The Indianapolis Car Co., of Indianapolis, Ind., is building 100 box cars for the Wisconsin Central.

Mr. Dyer, car-builder, of Strong, Me., has completed a contract for building freight cars for the Kennebec Central. He is now at work on a contract for 30 freight cars of 24 ins. gauge, for the new Phillips & Rangeley road.

The Missouri Car Works, of St. Louis, Mo., have built 500 box cars for the Cleveland, Chicago, Cincinnati & St. Louis.

The Chicago, St. Paul & Kansas City R. R. will purchase 24 passenger cars and 1,800 freight cars.

The New York Central R. R. is having between 5,000 and 6,000 new freight cars built; 2,000 box cars 34 ft. long, have been ordered from the Michigan Car Co., of Detroit, and 1,000 of the same style of cars from the Buffalo Car Co. The remainder are to be constructed in the company's shops at West Albany. Each car will have the Westinghouse brake and patent couplers.

Among recent orders, 10,000 freight cars have been ordered for the Pennsylvania lines west of Pittsburg. The Union Pacific has ordered 5,000; the Missouri Pacific, 3,000; the Baltimore & Ohio, 4,000; the Hocking Valley, 2,000, and the Ingalls syndicate, 2,000.

Street Cars.—The John Stephenson Co., of New York, has built some open summer cars, with 7 seats, for the Cable Tramway Co., of Providence, R. I.

The St. Charles Car Co., of St. Charles, Mo., has an order for electric cars for the Prospect Park line of the City & Suburban Ry. Co., Memphis, Tenn.

The Gilbert Car Co., of Troy, N. Y., has an order for 100 vestibule cars for the electric line of the Rochester Ry. Co., of Rochester, N. Y. They will be 18 ft. long over the body.

The Pullman Car Co., of Chicago, Ill., has built 4 open and 8 closed cars for the West Street & North End Electric Ry., of Seattle, Wash.

Steel Cars.—The Harvey Steel Car Co., of Chicago, Ill., has been incorporated by T. W. Harvey, G. L. Harvey and A. M. Turner. Capital stock, $1,000,000.

Train Signal.—It is proposed to establish works at Woburn, Mass., for the manufacture of the Johnston electric train signal, which is intended as a substitute for the bell cord. It is in use on the Boston, Revere Beach & Lynn R. R. The company has a capital stock of $500,000.

Interlocking.—An interlocking switch and signal apparatus, invented by Mr. J. J. Turner when Superintendent of the Indianapolis & Vincennes R. R., is in operation at Vincennes, Ind.

Spike.—Mr. W. P. Thurmond, of Forsythe, Ga., the inventor of the Thurmond car coupler, has patented a new railway spike. The device belongs to a class of spikes in which a separate key piece is driven after the spike to lock it in place.

The Purington Paving Brick Co., of Galesburg, Ill., has been incorporated by D. V. Purington, W. N. Phillips and A. A. Matthews. Capital stock, $100,000.

The Michigan Construction Co., of Milwaukee, Wis., has been incorporated at Milwaukee, Wis., by Ira C. Lillibridge, Leopold Kreilheimer and Arthur S. Goetz.

Railway Supplies.—The Railway Frog & Supply Manufacturing Co. will build works at Topeka, Kan. They will cover about three acres. It is proposed to go into the manufacture of frogs, crossings, car wheels and railway supplies generally. A general machine shop business will also be done.

Slide Valves.—The Bedbury Balance Slide Valve Co. has been organized at San Francisco, Cal. President, Geo. W. Bedbury; Secretary, H. D. Wallace. The valve is designed with especial regard for locomotive work.

The Pond Engineering Co. will furnish the Streator Electric Ry. Co., of Streator, Ill., a complete steam plant, including two 125 H. P. Armington & Sims engines, Hoppes feed-water-heater, pumps, pipe, etc.

English, Morse & Co., of Kansas City, Mo., report recent sales as follows: Pittsburg Gas Co., Pittsburg, Kan., one 125 H. P. "Ideal" engine. Boonville Electric Light Co., of Boonville, Mo., one 80 H. P. "Ideal" engine, with steel boiler and complete plant. Abernathy Furniture Co., Kansas City, Mo., one 30 H. P. "Ideal" engine with boiler, dynamo, motor and complete plant. Girard Electric Light Co., Girard, Kan., one 60 H. P. steel boiler. Also orders for Lahman-Kirkwood rocking grates, leather link belting, Hill clutch pulleys, Worthington steam pumps, etc.

Filters.—The National Water Purifying Co. reports contracts closed with J. W. Knowlton, Postmaster of Bridgeport, Conn., and the packing house of Sigmond Frietsch, Cincinnati, O., for National filter plants.

Metal Market Prices.—*Rails.*—New York: $32.50 to $33; old rails, $23.50 to $24 for iron. Chicago: $35; old rails, $22.50 to $23 for iron, $19 to $20 for steel. Pittsburg: $32 to $33; old rails, $21 to $24.50 for iron; $21 to $22 for steel.

Track Materials.—New York: steel angle bars, 1.75 cts.; spikes, 2 to 2.10 cts.; track bolts, 2.05 to 2.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.80 to 1.90 cts. for iron; spikes, 2.10, or 2.20 cts. delivered at Chicago or St. Louis; track bolts, 2.85 to 2.90 cts., with square, and 2.95 to 3 cts. with hexagon nuts. Chicago: splice bars, 2.10 to 2.25 cts. for steel, and 1.92½ cts. for iron; spikes, 2.05 to 2.10 cts.; track bolts, 2.85 to 2.90 cts., with hexagon nuts.

Pipe.—Cast-iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.05 to 4.10 cts.; Chicago, 3.85 to 3.95 cts.; St. Louis, 3.75 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared bridge plates, 2.80 cts.; universal mill plates, 2.40 cts.; refined bars, 1.92 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire-box; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.90 cts. for tank.